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The AIRCRAFT ENGINEER

...1578 ...XXXV

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FLIGHT
The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

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The Outlook

Poor Rowcy !

IN its Official Notices this week (p. 302) the Royal Aero Club announces that this year's regulations for the King's Cup Race "will establish it as the most remarkable air contest yet devised." That may very well be, although not, perhaps, quite in the way the Club Notices intended.

Although the full details have not been announced, it appears that the race is to be "open to all," provided they can maintain a speed of at least 140 m.p.h. There is no limit on engine power, and the course will be a short 20-mile one, flown in four sections of five laps each. Machines will be re-handicapped between sections, and "pulling" will be penalised (if proved!) by loss of marks.

Shades of Bournemouth! With a few Hurricanes and Spitfires (if the Air Ministry can be persuaded to lend a few for the day) and a couple of Albatrosses going "around the sticks" and overtaking the smaller fry which will be ambling along at 150 m.p.h. or so, there should be enough thrills to satisfy the most hardened spectator. At the Bournemouth meetings of ill-repute there were anything up to 70 or 80 machines taking part, but they were mostly slow—Moths and such-like, with ancient S.E.5s as the top notchers. And yet there were fatal collisions.

Messrs. Rowarth and Dancy, those inseparables whose names ought, for handicap purposes only and not in their official Air Ministry capacities, to be contracted into Rowcy, *will* have a lively time. If they are wise they will turn up at Birmingham (did we say Birmingham? Wonder what put that into our heads?), or at any rate at whichever "leading provincial airport" is selected, in chain mail and armour. An unfortunate competitor may get his airscrew into fine pitch during one of the sets, and afterwards improve his speed by getting it into coarse. Unless he could convince the officials that this had happened accidentally, he would be penalised for "pulling." In ordinary races Messrs. Rowcy do at least know whom they have offended even before the start. But after re-handicapping three times almost anyone is apt to go for them.

The C.A.G. Race

IT is quite a good idea to fly the race for Lord Wakefield's Challenge Trophy interleaved between the sets of the main King's Cup Race. At 85 m.p.h. and upwards the small machines will add a pleasant contrast to the projectiles, and as *Flight* has always believed, there is a feeling which can only be described as "intimacy" in watching slow machines going around turning points; a feeling which is lacking in the case of the really fast stuff, which must necessarily make a wide, sweeping turn.

As the official announcement states that the method of running and handicapping will be similar to those of the main race, it is to be assumed that re-handicapping between sets will be done where it is found necessary. The Rowcy slide rules will certainly be working overtime.

The postponement of the race until September is, on the whole, to be welcomed. Not only is the weather often particularly clear in early September (a race around pylons in thick weather would be impossible), but the extra time should make it possible to get finished in time for the race several machines which could not have been got ready earlier. This fact may help to swell the entries list, both for the King's Cup and the Wakefield Trophy.

It will certainly be interesting to see how the British version of the American National Air Races will turn out.

A Danger Averted

IN the last issue of *Flight* anxiety was expressed about the provision of an air element for the Army expeditionary force of 19 divisions, and we expressed the hope that some Member of Parliament would question the Government on the matter. Even before the issue had been circulated, that hope had been fulfilled. Evidently our previous remarks on the subject (in our issue of Feb. 9) had not escaped the notice of Parliament, where, as a matter of fact, the opinions of *Flight* on Air Force matters do carry considerable weight.

In the debate on the Army Estimates, on March 14, the Right Hon. Mr. Lees-Smith raised the matter from the front Opposition Bench. "The Army," he said, "cannot go abroad unless there are fighter squadrons with it to protect the Army co-operation squadrons. This is a very terrible dilemma, because those very fighter squadrons are the squadrons that will be required for home defence. I can imagine the feelings of a city which is being bombed if the fighter squadrons are taken away. On the other hand, I can imagine the dismay of the country as a whole if, because there are not fighter squadrons to go abroad, a vital point is lost while the Army remains unoccupied at home." He went on to refer to the paper read before the Royal United Service Institution in February by Group Capt. A. J. Capel on air support for the Army, and advocated, as *Flight* has advocated, that the Army should have a proportion of fighter squadrons, and that they should only be diverted away from the Army by the express consent of the Army Council.

THE OUTLOOK

All Parties Unanimous

IN defence questions there is now no real difference between the Government and the Opposition in Parliament; they only disagree as to the methods by which the goal of a strong Britain should be attained. Mr. Winston Churchill and Lord Apsley took up the argument and insisted on the need for fighter squadrons to protect the Army co-operation squadrons. Once the point had been raised, its vital importance was at once apparent to all sides of the House.

Mr. Hore-Belisha hastened to array himself on the side of the angels. His words were: "The air component of the field force includes a definite allotment of fighter squadrons which has been agreed between the War Office and the Air Ministry," and he went on to assure the House that the matter would have "our continuing attention."

It does not seem probable that this agreement is of very long standing. In the March issue of the *Air Force List* no fighter squadrons are included in No. 22 (Army Co-operation) Group, and no Group of Army Fighters has been instituted. All the fighter squadrons are still in No. 11 and No. 12 (Fighter) Groups, which seem designed for the protection of London and the more northern parts of the country respectively. Perhaps the fighters allotted to the Army are to remain camouflaged so as not to give information to foreign countries. If that is so, then the citizens of London and of the

"Flight" photograph.

GLADIATOR GOES TO SEA: A pleasant cloudscape impression of the Gloster Sea Gladiator (Bristol Mercury IX—840 h.p. at 14,000ft.). These machines are now going into service with the Fleet Air Arm. Two of the more obvious differences from the standard Gladiator are illustrated in another view on page 292.

(CONTINUED)

northern cities are left uncertain as to the number of fighter squadrons on which they can rely for their defence, and that is an undesirable state of affairs. The course of the debate suggests that this very necessary provision would not have been made but for the paper read by Group Capt. Capel and the attention drawn to his paper by the leading articles in *Flight*. We should like to offer our congratulations to Group Capt. Capel on the signal service which his paper has rendered to the general defence of British interests.

Air Strategy

CAVALRY used to be called "the arm of opportunity," and the mantle of the cavalry has mainly descended upon the bombers of the Air Force. In a debate in the House of Commons last week, Lord Chatfield seemed to lay it down that the main function of our bombers in war would be to destroy the enemy air fleets "whether they are in the air or elsewhere." Lord Trenchard disagreed, claiming a much more extensive rôle for our bombers.

If the enemy bombers are in the air, they can only be destroyed—so far as present tactics are concerned—by fighters. If they are on the ground, and when they are in the course of construction in the factories, they can only be destroyed by bombers. The functions of our bombers certainly cannot be limited to attacks on aerodromes and factories. They must be used to whatever is the best advantage at any particular moment of the conflict. If a land war is being waged, the enemy's army will need a lot of attention from our bombers; and when a battle is in progress attacks on the enemy troops must take precedence of attacks on factories. In between battles, the bombers should be used to attack the enemy's munitionment in the widest sense of the word, including means of distribution. On occasions there might be surprise assaults on the enemy fleet in harbour. In fact, the bomber force ought to be at the disposal of the Higher Command throughout a war, and not under the orders of any one Ministry or individual.

A Mysterious Accident

PIONEERING has always been fraught with risks. The Wright brothers took them, knowing little of how far full scale would tally with their wind-tunnel tests. Throughout the history of flying each new step has introduced a fresh risk, and always men have been found willing to face that risk for the sake of progress.

The whole world shares the grief which overtook American aviation last Saturday when the Boeing Stratoliner broke up in the air and crashed with the loss of all ten occupants. Among them were men known personally to many in England, and all of them were people who had contributed their share, in some form or other, towards progress in flying. Mr. Guillonard, of the K.L.M., had a great many friends in England, and von Baumhauer's loss is felt here the more keenly because only a few weeks ago he lectured to the Royal Aeronautical Society on stability and control.

As to the cause of the accident, it is scarcely possible to express an opinion. It is by no means certain that the fact that the machine had been built for high-altitude flying had anything to do with it. Many things would account for the crash; a tail broken by flutter or vibration, for instance, would put the machine completely out of control, and in the ensuing dive the wings might well come off. Or a broken airscrew might have caused so much vibration that the machine was shaken to pieces. The rumours of sabotage need not be taken seriously. They crop up after almost every accident, and usually there is not the slightest foundation for them.

On the other hand, high flying may have been the reason. The low temperatures may have embrittled the metal of some important structure member, or of an airscrew, and so have caused the accident. Until the Civil Aeronautics Authority has investigated and reported on the accident, speculations are futile. The most we can do is to extend to the Boeing company and to the relatives of those who lost their lives our sincere sympathy.

We Adopt the Shell-Gun—

AT long last an official utterance (by the Air Minister in the House on March 9) has enabled *Flight* to make reference to the fact that shell-firing automatic guns are to be issued to the R.A.F.

A large factory has been producing these weapons for some time past, and certain prototype aircraft are being developed to make the best use of them.

Meanwhile it is possible that the Hurricane and Spitfire single-seater fighters (now armed with eight rifle-calibre Browning machine guns) will be adapted to carry the new weapons. The least powerful installation which could be visualised for these machines would be two guns, one in each wing, firing clear of the airscrew arc. It is by no means impossible that four guns might be specified, assuming that the weapons concerned are of 20 or 23 mm. bore, like the Continental types. Already, Mr. Anthony Fokker has fitted two 23 mm. Madsen shell-guns to his fighter in company with a pair of Browning machine guns firing explosive bullets, though the *canon* fighters in general use abroad carry, at the most, two 20 mm. guns (with perhaps two small-bore machine guns), or, more commonly, one shell-gun mounted on a Hispano-Suiza engine and a pair of wing-mounted machine guns.

Guns of 37 mm. bore are being mounted experimentally, notably on the American Bell Airacuda twin-engined pusher fighter, which carries two such weapons. The British guns, for the time being at least, will almost certainly be of 20 or 23 mm. bore, and are rumoured, in fact, to be generally similar to the French 20 mm. models.

—And the Twin-Engined Fighter

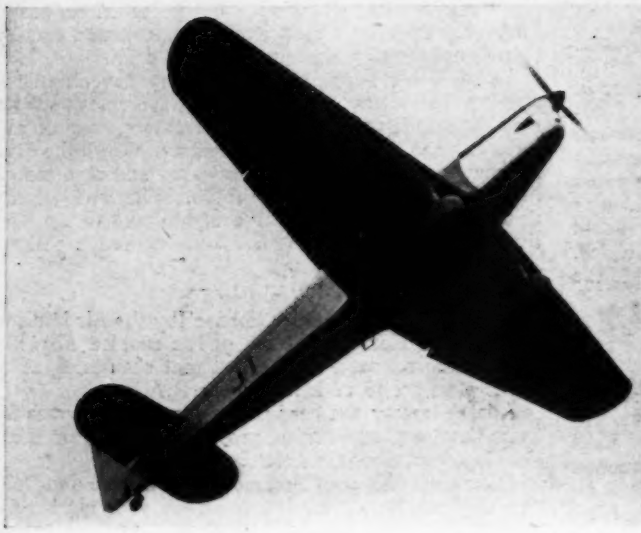
AS shell guns have been demonstrated abroad to work very satisfactorily when installed in batteries in the fuselage of a twin-engined fighter, the announcement that R.A.F. units are receiving training in the handling of aircraft of this type is doubly welcome. Actually, *Flight* suggested long ago that the Bristol Blenheim would make an admirable fighter trainer, while it has been evident since its specification was first announced that it could accommodate a number of shell guns at the expense of its bomb load.

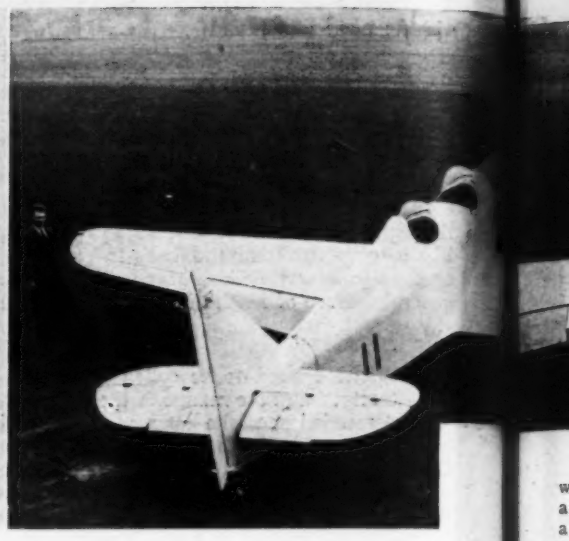
The present problem on the Continent is not so much how to house the shell-guns in a twin-engined tractor fighter, but whether they should be fixed or given a limited arc of movement, enabling a gun layer to correct any inaccuracy of aim on the part of the pilot.

Single-seaters, two-seaters, and three-seaters are chiefly favoured in the twin-engined class, though the Bell carries five men to assist in its primary purpose of destroying large bombers.

Les Ailes, our French contemporary, mentions a Westland twin-engined fighter capable of 435 m.p.h., though information on accommodation and armament is lacking.

DIARY OF FORTHCOMING EVENTS—Page 289.





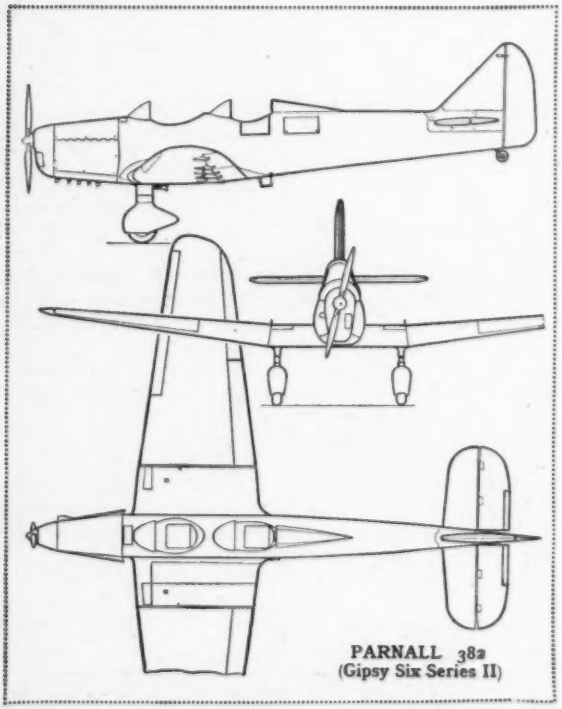
MODERNITY in a TRAINER

Advanced Features of the Parnall 382 : Slots and Slotted Flaps

(Illustrated with "Flight" Photographs and Sketches)

IN the Heck cabin monoplane, a few years ago, Mr. Basil B. Henderson demonstrated what could be done by combining Handley Page slots and slotted flaps with good aerodynamic and structural design. All the best features of the Heck have now been reproduced in a new *ab initio* training machine which has given a very satisfactory account of itself in trials at Yate aerodrome and Martlesham Heath.

The Parnall 382, as the type is designated, has been produced for *ab initio* training and conforms in many respects to an Air Ministry specification. Characteristics worthy of special note are the high-lift devices and the facilities for inspection. The engine is a Gipsy Six Series II driving a Schwartz-finished wooden airscrew.



PARNALL 382
(Gipsy Six Series II)

The wing, undercarriage and tail unit are almost identical with those of the Heck. Serviceability of these components is guaranteed by the fact that two Hecks have been in continuous use on the company's business for three years, and at no time has either been unserviceable for more than half a day on each normal twenty-five hour inspection.

Tapering in plan form and thickness, the cantilever wing is built in three sections. The outer sections carry Handley Page automatic slots, and flaps are fitted along 80 per cent. of the trailing edge. The inner sections of the flaps can be depressed to an angle of 45 degrees, while the outer portions, which function as ailerons, can be lowered about 15 degrees, still operating normally as ailerons when depressed to the fullest extent. Manual operation is provided for the flaps, permitting setting at any position between zero and maximum depression. The flap and aileron hinges are located beneath the wing on outriggers which transfer the load reaction to the main structure. The slots are of the automatic type and run on three tracks, supported on roller bearings. They are quite independent of the flap gear and are held closed by light springs. A locking device is fitted in the instructor's cockpit.

There are two main wing spars of "I" section with spruce flanges and plywood webs, the latter having spruce stiffeners at frequent intervals. The ribs have spruce flanges with spruce posts gusseted to them to form the internal bracing. Plywood covering is used for the entire wing.

Spruce longerons and plywood sides characterise the fuselage. The sides are assembled as complete units and the fuselage structure is formed in the assembly jig, with bulkheads at suitable intervals. Actually, the fuselage is in two halves, the junction being aft of the rear cockpit.

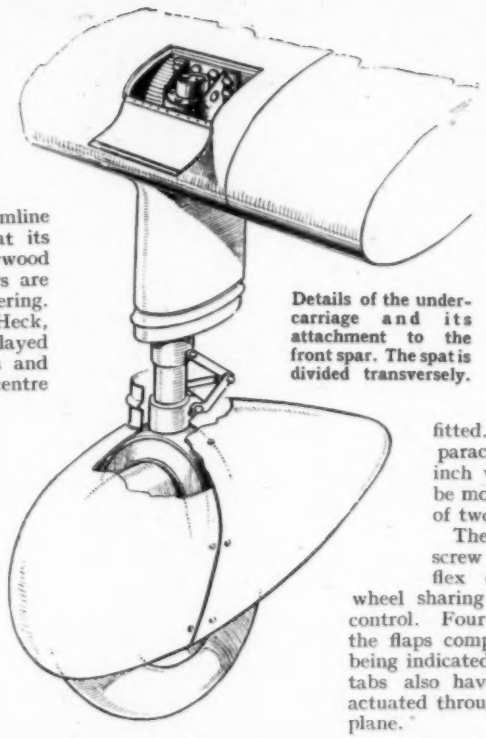
The tailplane is fixed to the top longerons by steel-plate fittings, horizontal trim being adjusted by tabs on the trailing edge of the elevator, and the elevator hinges are so arranged that there is practically no gap at the junction

The three views above give a good idea of the general layout of the Parnall 382.

with the tailplane. Constructed as a unit, the fin is attached in such a manner that the side loads are transferred to the fuselage at the fin post and at another point two bays further forward. The rudder is hinged to the fin post in a similar manner to that used for the elevator-tailplane joint. There is no aerodynamic balance and the mass balance weights are carried on streamline tubes attached to the rudder spar at its top end. The tailplane and fin are plywood covered, but the rudder and elevators are of wooden construction with fabric covering.

Although resembling that of the Heck, the cantilever undercarriage is not splayed out. It incorporates Lockheed legs and Parnall forks and is carried on the centre section spar by built-up duralumin fittings bolted to the spar at the wing joint fittings. The fairings have been designed to provide additional stiffening against braking loads. Dunlop hydraulic brakes are fitted, being operated by a hand lever on the port side of the pilot's seat. Differential control is provided from the rudder bar.

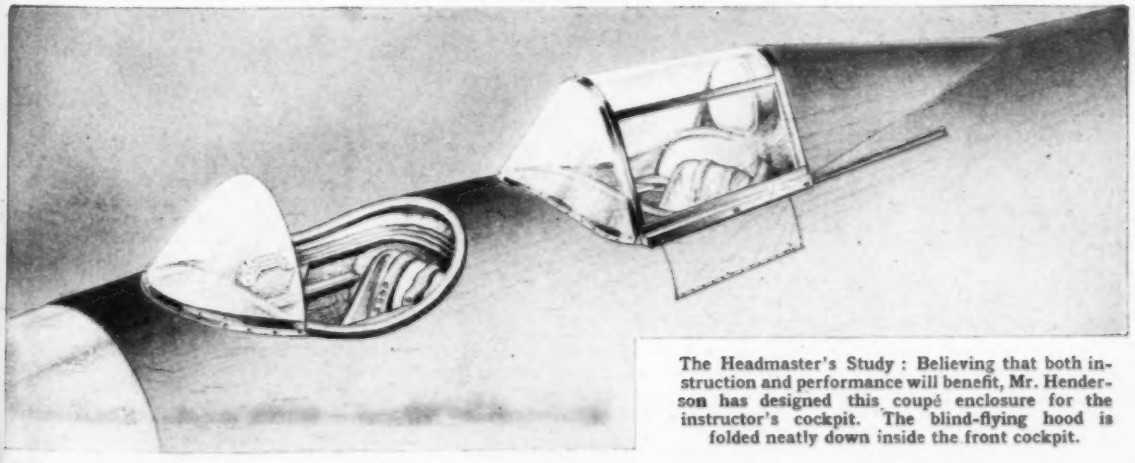
The welded engine mounting is attached to the front of the fuselage by four bolts, and since quick-release couplings are incorporated in each pipe line, engine changing is very rapid.



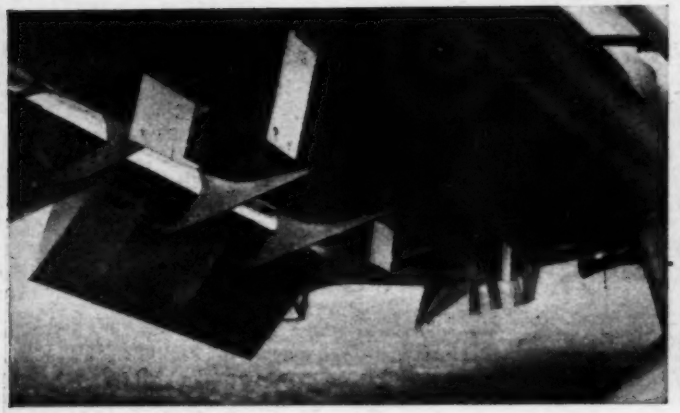
Details of the undercarriage and its attachment to the front spar. The spat is divided transversely.

The layout of the two tandem cockpits is almost identical. Since the front cockpit, which is occupied by the pupil, is used during solo flights it accommodates all the starting controls and electrical equipment. A dummy undercarriage retraction control and folding blind flying hood which, when raised, fits inside the windscreen, are also fitted. The "Bungee"-loaded parachute-type seats have a four-inch vertical adjustment and may be moved fore and aft over a range of two inches.

The flaps are operated through a screw jack arrangement with Teleflex controls, the flap-operating wheel sharing the same shaft as the tab control. Four turns of the wheel will lower the flaps completely, intermediate settings being indicated on the control panel. The tabs also have Teleflex controls and are actuated through a torque shaft in the tailplane.



The Headmaster's Study: Believing that both instruction and performance will benefit, Mr. Henderson has designed this coupé enclosure for the instructor's cockpit. The blind-flying hood is folded neatly down inside the front cockpit.



(Left) "Slottery and flappery" is an important feature of the Parnall's specification. The inner portions of the flaps can be depressed to 45 deg. and the outer portions, which function as ailerons, can be lowered about 15 deg. The other appendages are the numerous inspection doors, shown open. (Right) Mr. B. B. Henderson, the designer, with Mr. J. A. C. Warren, test pilot—whose headgear tempts us to pin a quip on his name.

The rear (instructor's) cockpit may have a sliding coupé roof which is calculated to benefit not only the temper of the occupant but the performance of the machine. A brake cut-out lever is another comforting feature.

The particularly neat Perspex windscreens are explained by the company's moulding experience in connection with the Nash and Thompson gun turrets.

Thirty-six gallons of petrol—sufficient for a cruising duration of three hours—is carried in two wing tanks, the gauge being under a Perspex window in the wing. The three-gallon oil tank will, in production machines, be mounted in the leading edge.

Inspection doors are located over the whole length of the fuselage and at appropriate points in the wing.

Data for the Parnall 382 Trainer are: Span, 33ft. 8in.; length, 28ft. 9½in.; track, 6ft. 10in.; wing area, 155 sq. ft.; wing section, B.H. 5; tare weight, 1,655 lb.; all-up weight, 2,450 lb.; top speed, 155 m.p.h.; take-off run, 180 yd.

Mr. Henderson tells us that, by using the slots and flaps the machine can be flown at 43 m.p.h. with the engine on. The stall is not reached until the angle of incidence is over 30 degrees, eliminating the possibility of accidental stalling on the glide. Mr. J. A. C. Warren, the company's test pilot, has dived the machine up to 265 m.p.h

"HUGHES OF FENCHURCH STREET"

Celebrating a Centenary

FLYING is still regarded by most as a newfangled notion, and a favourite phrase is to talk of it as being "still in its infancy." When applied to flying *as* flying, the expression is certainly not very applicable. But if by flying one means getting from A to B and back again safely, and in a minimum of time, a case can very well be made out for the beginner point of view. Aerial navigation *is* in its infancy and is the one branch of flying in which we still have a great deal to learn. Fortunately for this country, we have the brains and the mechanical skill to keep in the very forefront in this particular field, and it is, perhaps, significant that at least one firm of instrument makers, whose name has been associated with air navigation since the earliest flying days, celebrated its centenary last week.

"Hughes of Fenchurch Street" is a pame familiar to generations of sailors, whether of the Merchant Navy or of its "younger sister" (as Admiral Sir Edward Evans called it) the Royal Navy. And there were Hugheses (how *does* one spell that plural?) long before that who made navigation instruments.

Last Friday Henry Hughes and Sons celebrated their 100 years of occupation of No. 59, Fenchurch Street, "in the Port of London," by a dinner at the Savoy Hotel. Sir Robert Burton-Chadwick, Bt., was in the chair and recalled that the name was an honoured one in connection with instruments, and had been handed down from father to son. He had read, for instance, of William Hughes in the middle of the 18th century, then of his son Jasper, and of *his* son Henry. The present head was Arthur Hughes, whose son Francis (cries of "Francis, where are you?") brought the long line up to date.

Mr. Arthur Hughes referred to the early navigators and their instruments. In those days navigation and navigation instruments were treated as mysteries, and the secrets were passed on from father to son. Nowadays, fortunately, navigation was not on the "secret list." Navigation was originally developed by robbers and smugglers and by the Vikings. From Iceland the latter reached Newfoundland, making use of a primitive instrument which consisted of a circular shield with a nail in the centre.

After recalling the good work done by early air navigators, Mr. Hughes paid a tribute to the Government research departments, with which he had been proud to co-operate. He said quite frankly that without those departments the perfecting of the bubble sextant would not have been possible.

Admiral Sir Edward R. G. R. Evans, K.C.B., D.S.O., LL.D. ("Evans of the Broke"), pointed out that the celebration was being held on St. Patrick's Day, a day held in great esteem in the "Royal Irish Republic." He recalled that if the Arctic and Antarctic were classed as additional to the "seven seas," he had sailed all nine in safety, thanks largely to Hughes instruments. He paid a tribute to Captain Oates (of Scott Antarctic fame) and many others who had carried navigation to the far corners of the world.

The gallant Admiral concluded by explaining that after having been, as he put it, "a little tin god" as Admiral of the Nore for years, he did not take kindly to an inspection by the Board of Admiralty. He got over the difficulty by borrowing a Short flying boat and taking the Board around the Thames Estuary. When it was pointed out to him that he had an alarming number of great people on board, and the question was asked whether the young man at the wheel really knew his job, he said "Yes, I think so. I call him 'Brackles.'" The pilot was Major Brackley, flight superintendent of Imperial Airways!

Mr. H. E. Wimperis, who replied for the air navigators present, pointed out that one of the difficulties of air navigation was that the "tides" might reach a speed of 100 m.p.h. He told an amusing story of some tests at Farnborough with steel darts early in the last war. The darts had been dropped from an aeroplane and two R.F.C. officers went out on Laffans Plain to mark each dart with a piece of white paper so that the "scatter" could be photographed from the aid. Just as they had finished a cavalry officer came along. He was very intrigued, and the R.F.C. explained, as they thought, the idea of it all. To which the cavalry officer replied: "Well, I would never have believed such accuracy possible."

Mr. A. Gordon Smith, chairman of Smith's Aircraft Instruments, explained the great qualifications of Sir Robert Burton-Chadwick to take the chair that evening, and modestly expressed his pleasure that Smiths had been able to co-operate with Henry Hughes and Sons in organising production and distribution of Hughes instruments.

MORE ABOUT the AIR ESTIMATES

Pertinent Questions Asked, but No Obstructionist Methods

LAST week we recorded the speech with which, on March 9, Sir Kingsley Wood introduced the 1939 Air Estimates in the House of Commons. Space did not permit us to deal with the debate which followed. That is summarised in the following pages.

MR. DALTON covered a great deal of ground. So much so that it is impossible for us to do more than indicate briefly the subjects on which he spoke. He wanted to know whether the gap between the effective first-line air strength of this country and the first-line strength of the most powerful air force within striking distance was being narrowed.

He would like to be reassured that our Spitfire and Hurricane fighters were as satisfactory as they could be made for the purposes they would be required to serve. He believed there was a good deal of controversy about them, and thought that the Air Ministry, Farnborough and the industry itself had not always agreed on this point.

He asked whether the shortage of blind-flying equipment, de-icing equipment, guns, turrets, sights and sextants disclosed last May had been overcome. He would like to know how the McLintock agreement was going to be modified for the benefit of the taxpayer.

Referring to the earnings of various aircraft companies, Mr. Dalton said that, taking a rough average, they earned 82 per cent. on their capital and paid in dividends 42½ per cent. It was to be noted that this was after deduction of income tax and national defence contribution. He thought it was a very tardy act of readjustment that the McLintock agreement should now be under review. He recalled that the Royal Commission on the private manufacture of arms recommended in 1936 that all branches of the defence services should have some element of genuine State manufacture in order that the costs of production in private firms might be checked by comparable figures in a Government establishment. That had been put on one side and shelved by the Air Ministry.

Mr. Dalton also wanted to know what progress had been made with the camouflaging of aerodromes. He had recently been invited to look at some of the aerodromes from the air and was not in the least reassured by what he saw. He believed the Under-Secretary of State for Air was not very reassured either. Here Capt. Balfour interposed the remark that the camouflage was so good that he (Capt. Balfour) could not find the hangars.

Paper Maintenance

His information was that the maintenance command existed on paper only and was not yet functioning effectively. That led him to the question of the whole organisation of the R.A.F. It was notorious that there had been great differences of opinion within the R.A.F. He understood a Committee of Investigation was now sitting and hoped these problems would be worked out and settled in a way which would meet the views of officers of the commands. He hoped that the views of officers outside the Air Ministry, who would have to take command and make quick decisions in time of war, would be given at least as much weight as the views of those who had been for a long time secluded away at desks inside the Air Ministry.

Turning to the subject of the balloon barrage, Mr. Dalton said if there was any value in the balloon barrage it was a serious thing that the greater part of the country was still without any protection from it. In the Midlands where the Air Ministry had been adding target to target in a most terrible fashion it was a very serious thing that the balloon barrage was still not available.

SIR HUGH SEELY said he would like to congratulate the Air Minister and the Under-Secretary on the industry which they had put into their work. He did not blame Lord Swinton for what had happened in the past. For that he blamed the Government, which started rearmament so late. But there was a lag between the time when it was realised that dangers had to be met and the time when something was done about it, and for that lag he did blame Lord Swinton and the Air Ministry.

He was not impressed by the figure of 1,750 for our first-line strength. Anyone with a knowledge of the German figures knew that she was twice as strong as we. But Germany's problems were different from ours.

He warned the Air Minister to be careful in considering the fighter policy. Germany and Italy had been on active service during the last two years, and their views were, therefore, worthy of the greatest consideration. He asked the Minister to consider the policy of single-seater fighters with eight Browning guns, and whether the two-seater fighter with heavier guns would not have to be the policy in the future. From talking to German and Italian pilots he had come to the conclusion that to follow a bomber in a single-seater fighter was rather like firing on a retreating elephant with a .22 rifle.

Sir Hugh Seely said that the accidents figures showed that last year 218 were killed and 166 injured in R.A.F. accidents. Bearing in mind the hours flown, those figures need not cause alarm. The best information he could get gave the accidents in Germany last year as 700.

MR. O. E. SIMMONDS paid tributes to two who had done much to place air matters on the prominent footing they occupied to-day: Sir Murray Sueter and Capt. Guest. He slightly blamed the Air Minister for not having made the most of the Air Estimates. "I have always," he said, "looked upon my right hon. friend the Secretary of State as one of the best publicists and showmen the Government have had, but I am not sure that in presenting these Estimates he has brought home to the country exactly what it is that has been achieved. I take an example from p. 5 of the Memorandum. It says that during 1939 the strength of the R.A.F. is expected to rise to 118,000. That is true as regards Vote A, but there is the Vote for the R.A.F. Reserve and Volunteer Reserve, 77,000 men, and the Auxiliary Air Force and the A.A.F. Reserve, 27,000 men, bringing the total up to 222,000 of all ranks. With the civil training schools and the university air squadrons we might have during this year 250,000 officers and men in all ranks of the R.A.F. and its ancillary services. That is something about which the country ought to be told."

The McLintock Agreement

MR. STOKES criticised the Air Ministry's system of profit control, and said he was staggered when told that Sir William McLintock had been asked to carry out investigations. His history in regard to profit estimating in the City had not been very good. He also criticised Imperial Airways and said they were unpunctual. He himself had been told that if the mail load taken on in the middle of the voyage to Egypt was too heavy he would be "jettisoned."

SIR W. LINDSAY EVERARD did not agree with speakers who had said that time was not in our favour in the matter of production. German preponderance in aircraft built in the past was day by day becoming more obsolescent, and consequently of less danger to this country. While admitting that the majority of municipal and other civil aerodromes were being used by the R.A.F., the A.A.F. and so forth, there were still many at which no service flying was being done.

MR. ECKERSLEY expressed the hope that something would be done to provide for turning over to civil aircraft some of the thousands now working on military aircraft when the present expansion was over. He wanted more direct routes from the Midlands and the North, and suggested that a service might leave Glasgow at 7 in the morning, Manchester at 8.15, and arrive at Croydon about 9.45 in time to catch the European morning services. A return machine should leave Croydon about 6.15 in the evening and could reach Glasgow at nine the same evening.

WING COMMANDER WRIGHT gave two reasons why he thought the immediate development of civil aviation of vital importance. The first was that he wanted to be able to absorb the skill and knowledge, and the expensive plant accumulated during the expansion; the second was that in civil aviation he thought we had to make up leeway. He went on to elaborate this by explaining that our ultimate aim should be the economical carriage of passengers and freight to time schedules in all sorts of weather by day and by night. The first essential to making that possible was the provision of suitable airports. Next came directional control. And, finally, came the aircraft themselves. Here he wanted specialised aircraft: fast and comfortable for passengers; less fast, but suitable for carrying bulky loads, for freight. He did not agree that all external traffic should go through London. He asked the Air Minister to consider the establishment of at least one internal bad-visibility route on which aircraft could operate in all weather conditions by day and by night.

MR. J. RATHBONE joined with Mr. Stokes in criticising Imperial Airways. He said that those who had done the trip before regretted their inability to travel by some other line. At present the Empire boats were neither passenger-carrying nor mail-carrying boats.

CAPT. CAZALET pleaded for specialisation in aircraft. He

did not share the views of previous speakers about British air routes, but did suggest that there should be, for the long over-sea services, two different types, one for mails and one for passengers.

THE UNDER-SECRETARY OF STATE FOR AIR, Capt. Balfour, reminded the hon. Member for the Exchange Division, who had come from a bed of sickness, that modern medical opinion is that a flight to 10,000ft. is one of the best remedies for influenza and colds. He recalled that the Government had allocated an annual sum of £10,000 for the next five years for assisting internal civil aviation. Operators could not expect that the whole of that sum would be earned this year as something had to be reserved for extensions to existing lines. The new Licensing Authority had rationalised air routes as between fourteen companies and had issued so far thirty-seven provisional licences.

Capt Balfour said that centres and schools for training R.A.F. pilots were operating at twenty-nine civil airports—fourteen municipal and fifteen private. Negotiations had been concluded for the use of a further thirteen before July, and the use of a further twenty was being considered.

The Under-Secretary of State for Air then mentioned a new basis for payment at aerodromes which, he thought, would meet the wishes of owners as well as users. Radio and meteorological services were being extended, and soon fifteen of the nineteen high-frequency beacons visualised by the Maybury Committee would be available. He explained that a central London airport would be impracticable, but that the Air Ministry was concentrating on a ring of airports around London. He mentioned Heston and Fairlop, with Croydon being reconstructed, and Lullingstone as a later addition.

Turning to the question of new suitable aircraft, Capt. Balfour said that the Air Ministry had asked operators to get together and agree on a specification. Apart from this, three new types of civil aircraft were being produced. The Short 14/38 was a landplane, of which three prototypes were being built, two for medium altitude and one for high altitude. The cruising speed of the latter was calculated to be 275 m.p.h. at 25,000ft. The other two would cruise at 245 m.p.h. at a lower height. The first low-altitude type was expected to fly some time in 1940. Yet another type was a low-wing all-metal monoplane with two engines, capable of carrying thirty passengers at 205 m.p.h. To help Imperial and British Airways the Air Ministry had placed orders for two prototypes and a further twelve production machines. [This obviously refers to the Fairey.—ED.] Of De Havillands he said that to encourage a speeding-up of production the Air Ministry had entered into a subsidy arrangement with the company on a sliding scale. Then there was the new Short G-class flying boat, which would weigh 71,000 lb. and have a range of 3,200 miles.

A *Naval Broadside*

LT. CDR. FLETCHER took up a great deal of the time of the House with an exposure of the case which came to light in the course of the investigations of the Rae Committee, in which two Civil Servants in the Directorate of Civil Aviation were referred to as "Mr. A." and "Mr. B." respectively.

REAR ADMIRAL SIR MURRAY SUETER pleaded for duplication of the operating system of retractable undercarriages. He did not agree with the criticisms of Imperial Airways, and recalled that the company carried 300 tons of Christmas air mail.

MR. BATEY complained of the policy of placing orders in America when so many men were out of work in this country. He wanted to know what the Government had done about the supply of oil, and why more effort was not made to produce more oil in this country.

LT. COL. MOORE-BRABAZON welcomed the extra expenditure on our air defence. It was said that money talked. He hoped that money would now scream across the world and tell the world what we were doing. He wanted to know whether our supply of engines had now become such that we could afford to put two in fighters and six in long-range bombers. The Air Minister had said nothing about cannons. He hoped our long-range bombers would soon be fitted with cannons. He put in a plea for the small gyroplane, which was the type of machine for which there would be a great demand.

MR. GARRO JONES hoped the Government was making plans for the day when we should turn over from war to peace production. He also had something to say on the subject of aircraft manufacturers' profits and the Air Ministry's methods of price-fixing. He wanted particulars of the McLintock agreement. He had a good deal to say about the mysterious shareholders of Imperial and British Airways.

With reference to the number of accidents in Germany and in this country, he pointed out that the explanation of the 700 accidents in Germany compared with the 200 in this country might be that the number of flying hours in the German air force was greater. He pleaded for a closer relationship with Soviet Russia.

MR. AUSTIN HOPKINSON criticised the raising of the age of entry for short-service commissions. He did not believe the gap between Germany's aircraft production and ours was narrowing. He was also dissatisfied with the new McLintock agreement being drafted by the same gentleman who drafted the original agreement. He criticised the staff work of the R.A.F., and said that although the staff knew four years ago that the fighter squadrons were to have Hurricanes, the service had to evolve suitable tactics after the machines were delivered. He did not quite believe in the beautiful love between the Air Ministry and the Fleet Air Arm. And he suggested that, with experience in quantity production of aircraft, there was no reason why we should not go back to the system of competitive tender.

MR. GRANT-FERRIS said that anyone who went around the country would discover that it was almost impossible to find a station at which new aircraft were not being flown. He thought Germany had her production troubles, mainly in connection with raw materials, and that by the end of this summer we should close the gap. He bore out Capt. Balfour's remark that recent camouflage of aerodromes was very good. He did not agree with the criticisms of the Air Staff. The staff work was very good. The Auxiliary Air Force squadrons were delighted to have been converted from bomber squadrons into fighter squadrons. Their expectations of life had gone up from three days to a few weeks.

MR. ELLIS SMITH spoke for the aircraft workers. He suggested that the time had come for considering the setting up of a National Aircraft Consultative Council. Of these who make aero engines he said that they often go to night school for five or six years. They have to have a good geometrical and mathemetical knowledge, and their interest in the engines they make is as great as if they were making the engines for themselves. And yet they can see before them the time when their labour will no longer be needed.

SIR KINGSLEY WOOD explained the position of Sir William McLintock. He had been consulted by the aircraft industry and would act as their representative. There was no question of him drafting the new agreement. He assured the House that all aircraft now being delivered were complete with turrets.

In his reply, Sir Kingsley Wood made some interesting disclosures. For instance, he said that a factory for the manufacture of cannons existed and that it was in production on a considerable scale. He mentioned the possibility of adapting the existing types of fighter for the use of cannon, and said that steps had been taken to provide fighter squadrons with practice on other types of aircraft.

Of the Nuffield factory, the Air Minister said that steps were being taken to complete a part of the factory in advance of the whole.

AIR POWER: THE TRUE INDEX

MANY people claim to be authorities on the subject of comparative air strengths of the nations of the world, but figures are of little value unless something is known of the *quality* of the material which they represent.

All those who seek guidance as to the capabilities of the various aircraft now in service, or about to go into service, will be able to obtain valuable and accurate information from next week's special issue of *Flight*, which will be a

BRITISH AND FOREIGN MILITARY AIRCRAFT NUMBER.

A table of data will present in concise form hundreds of facts about the characteristics and capabilities of the more noteworthy products of all the aircraft-producing nations. Design from the military aspect will be authoritatively reviewed, and a special article will explain some modern developments in aircraft armament, about which, in spite of foreign secrecy, a surprising amount is known.

Next Week FLIGHT *March 30*

"Flight" photograph.

MASTERLY: The Miles Master high-speed advanced trainer as now in large-scale production for the R.A.F. Actually, the machine seen here (with Mr. Skinner taking it up to 25,000ft. for tests), is the revised prototype with Rolls-Royce Kestrel XVI engine which gives it a top speed of 295 m.p.h. The production version will have the less powerful Kestrel XXX and will do nearly 270 m.p.h.

HERE and THERE

The R.Ae.S. Removal

ON March 25, the Royal Aeronautical Society will move to its new headquarters, No. 4, Hamilton Place, London, W.1.

Up to and including March 25 all correspondence should be sent to the present address, 7, Albemarle Street. *After* that date it should be addressed to 4, Hamilton Place. The new telephone numbers will be Grosvenor 3515 and 3516.

An "M" and "S" Hercules

MENTION is made in *Les Ailes* of a version of the Bristol Hercules two-row sleeve-valve engine fitted with a two-speed supercharger. It is said to be designated the Hercules IV and, operating on fuel of 100 octane number, develops 1,570 h.p. for take-off, 1,420 h.p. at 4,920ft., and 1,290 h.p. at 14,760ft.

The Hercules I (moderately supercharged) has been homologated at Chalais-Meudon. Presumably alterations will be made to bring this engine into line with the Hercules II, which has superseded the Series I in this country.

Two Hercules of unspecified mark are to be fitted in a production-type Lioré et Olivier 45 bomber, which normally has either Hispano-Suiza or Gnome-Rhone two-row radials of about 1,000 h.p. each.

Two Films

TWO flying pictures have lately been showing in London—one English, the other American. The English effort, *It's in the Air*, appears to have been adopted as semi-official recruiting propaganda. It is classed as a comedy and has apparently proved quite a draw—which no doubt must be attributed to the fact that Mr. George Formby is the star. The film's première was attended by the Air Minister and a number of senior officers of the Royal Air Force, while the R.A.F. Central Band performed.

Frankly, such recognition was quite undeserved. The film is crudely made and there is next to no flying, though a cardboard Audax does perform ridiculous antics in the path of a squadron of American Curtiss Condor bombers, *circa* 1927.

In at least one London cinema the showing of this film has prompted a uniformed R.A.F. recruiting officer to take the stage. He was nervous at first, then over-bold, and rounded off his little piece in a welter of bathos which caused one to writhe visibly.

The second effort, a Hollywood production with a largely British cast, is *The Dawn Patrol*, a revised version of an earlier picture of the same name. This differs from the Formby comedy (or, more accurately, tragedy) as calcium carbonate from full-flavoured Camembert. Real war-time Nieuports (not the V-strutters, but of an extremely attractive parallel-strutted variety) perform as war-time Nieuports did. There is much serious drinking and a little hysteria, although there are no women in the cast. An enemy aerodrome is well and truly shot up, and a railhead goes skyhigh with awesome din.

There are mistakes, of course. The period is 1915 according to a caption, though the equipment used and the circumstances pictured came later in the War. Aeroplanes are called ships.

Nevertheless, if official favours are to be lavished on a film, surely *Dawn Patrol*, with its heroism and genuine thrills, is infinitely preferable to the Formby burlesque.

Gatwick Goes Gay

THE staff and pupils of No. 19 Elementary and Reserve Flying Training School, Gatwick, entertained themselves and a worthy selection of friends at a dance in the airport buildings last Friday night. The entertainment, be it said, was certainly not elementary, though we should hesitate to say that it was not reserved. Revellers included Mr. Marcel Desoutter (Airports, Ltd.), Mr. Simpson (Airwork) and Mr. G. B. S. Errington, Airspeed's chief test pilot.

Forthcoming Events

MARCH.

Thurs., 30th. R.Ae.S. Lecture*: "The Problem of Ancillary Power Services on Aircraft," by R. H. Chaplin, B.Sc., A.F.R.Ae.S., and F. Nixon, B. Sc., R.Ae.S.

Aero Golfing Society: Instone Trophy, Royal Wimbledon.

APRIL.

Sat., 15th. Opening of West Hartlepool Airport by the Secretary of State for Air.

Thurs., 20th. R.Ae.S. Lecture*: "Possible Steel Developments," by Dr. T. Swinden, F.R.Ae.S.

Fri., 21st. Norfolk and Norwich Aero Club: Annual Dinner and Dance.

Sat., 22nd. Aero Golfing Society: Match v. R.A.F. Martlesham and Felixstowe.

MAY.

Thurs., 4th. R.Ae.S. Lecture*: "Strength of Thin Metal Construction," by H. L. Cox.

Sun., 14th. R.Ae.S. Garden Party, Fairey's Great West Aerodrome.

Tues., 16th. Aero Golfing Society: "Flight" Trophy, Wentworth.

Sat., 20th. Empire Air Day.

Thurs., 25th. R.Ae.S. Wilbur Wright Memorial Lecture by Dr. G. W. Lewis.

Sat., 27th. London-I.O.M. Race.

Mon., 29th. Manx Air Derby and Tynwald Race.

* All these lectures take place at 6.30 p.m. at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

CARBURETTER or INJECTION?

Relative Merits Reviewed : R.Ae.S. Lecture by Messrs. J. E. Ellor and F. M. Owner

AFTER examining the subject in great detail, the authors of the paper on petrol injection or carburetters, J. E. Ellor and F. M. Owner, presented to the Royal Aeronautical Society last Thursday, came to the conclusion that "Such evidence as is available in connection with multi-cylinder engines indicates no improvement in either power or consumption compared with the carburetter system, nor is there any good reason to expect more from the same cylinder compression ratio, assuming good distribution with the existing system."

The official title of the paper was "A Review of the Relative Merits of Petrol Injection and Carburetters for Aero Engines," and the authors pointed out that, owing to the meagre amount of information available on fuel injection, the paper was not as complete a review as they would have wished. In assessing the relative merits, due considerations should be given to (1) improvement in performance; (2) simplification of operation and servicing; (3) facilities and cheapness of production; and (4) reliability.

Three distinct principles, the authors stated, are involved in the possible methods of introducing the fuel into the engine cylinders: (1) continuous induced flow, as in the case of the carburetter; (2) continuous injection; and (3) timed injection.

One of the early sections of the paper dealt with the history of fuel injection, and was followed with a chapter on the problems of carburation. Then descriptions were given of modern carburetters. Continuous injection was described by the authors as the half-way line towards timed injection. It had the advantage that the density of the gas was increased, due to the cooling effect of the evaporation of the fuel. This had considerable effect on the pressure rise across a given blower and the power required to drive it was reduced. Unfortunately the gain depended largely on the volatility of the fuel so that the gain at altitude might not be so great.

Timed Injection

Four main advantages of timed injection were mentioned by the authors: (1) Positive metering to each cylinder, giving perfect distribution; (2) reduction in fire risk by eliminating backfires and by using safety fuels; (3) improved combustion chamber scavenging and cooling by appropriate valve injection timing; and (4) freedom from icing. Diesel experience had shown the problems of accurate metering to be soluble, but the pumps must necessarily be precision instruments. The possibility of using safety fuels was due to the fact that the injectors were placed close to or inside the combustion chamber. Controlled turbulence was used to get an even charge, but turbulence was a difficult factor to control. The authors thought the ideal would be the use of a stratified charge for economic operation and a uniform charge for maximum power. It might be possible to use low-grade fuels for cruising.

Tests with large valve overlaps had shown improvement in B.M.E.P. as great as 10 lb./sq. in. but there were a number of difficulties. The revival of the exhaust gas turbine might alter the position, as the back pressure tended to follow variations in boost and to be independent of altitude. These were the conditions required for good scavenging.

Manifold injection was easy to arrange, and an engine designed for carburettor operation could readily be converted. The Bristol "Draco" engine of a few years ago employed that system.

Combustion Chamber Injection

Although having obvious similarities, diesel practice and petrol injection remained fundamentally different. The diesel required a slow-burning fuel which was easy to ignite, while the petrol engine wanted a rapidly burning fuel, difficult to ignite. The mechanical problems of the two types were similar. In the petrol engine using injection directly into the combustion chamber, the problem was simplified because the injection period occurred during the induction stroke, so that a longer period was available for mixing.

The authors then discussed various control systems, and concluded with a general summary, which is given in full hereafter.

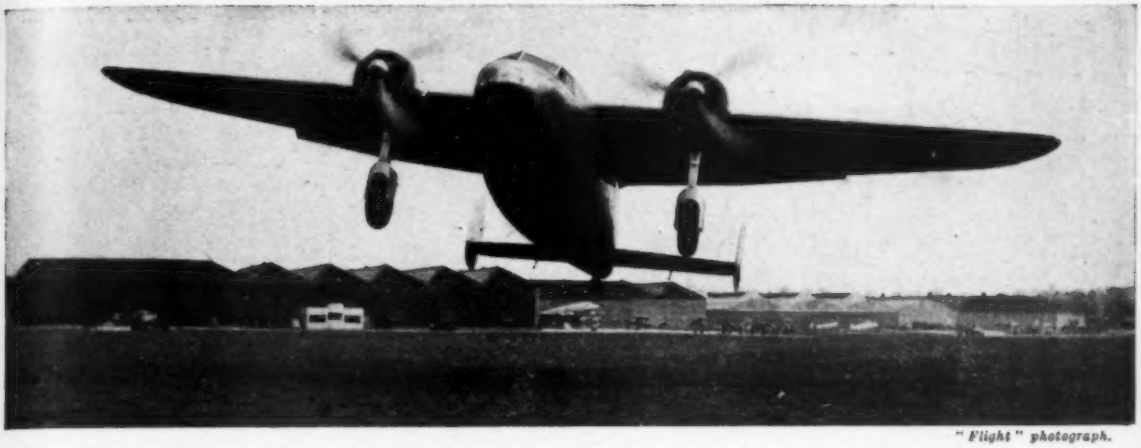
"In view of the mass of experience behind the universal adoption of the carburetter, its displacement by any form of fuel injection system can only be brought about by a convincing demonstration of the latter's general superiority. Although carburetter systems now operate reasonably satisfactorily, there undoubtedly exist a number of inherent undesirable features, but it is believed that the few functional troubles sometimes encountered will definitely be eliminated, thus rendering such systems 100 per cent. reliable. This from the pilot's point of view is of primary importance. His next worry in order of importance is the complication of manual control, especially on multi-engine machines. To minimise the number of controls and to ensure minimum fuel consumptions compatible with engine requirements, automatic devices are incorporated and calibrated during flight to suit operational demands. The careful thought and extensive development put into these devices have provided a fairly satisfactory solution in the fully automatically controlled carburetter. At the moment, two controls per engine are arranged in the pilot's compartment, the main throttle and a two position, weak and normal mixture strength, lever, which will probably be eliminated by the latter development. The absence of material facts based on extensive development rather handicaps the case for fuel injection and leaves a good deal for conjecture.

(*Concluded on page* 299.)

COMPARISON BETWEEN CARBURETTER AND PETROL INJECTION

	Carburetter	Continuous Injection	Timed Injection	
			Induction Pipe	Combustion Chamber
Distribution	Dependent on induction system.		Excellent.	Excellent.
Atomisation	Dependent on jet characteristics.	Very good.	Moderately good.	Moderate.
Freezing	Can be prevented by special precautions.	Eliminated.	Eliminated.	Eliminated.
Cooling effect of petrol on charge ...	Considerable.	Considerable.	Small.	Negligible.
Cooling effect of petrol on charge in combustion chamber.	Small.	Small.	Measurable in single cylinder unit.	Possible increased breathing due to reduction in residual gas temperature.
Effect on supercharger	Improves performance.		None.	None.
Scavenging	Impossible without loss of fuel.		Feasible.	Feasible.
Fire risk (backfires)	Eliminated by use of flame traps.		Eliminated.	Eliminated.
Use of safety fuels	Impossible.	Difficult.	Possible.	Easy.
Aerobatics	Reasonably satisfactory.	Good.	Good.	Good.
Acceleration of engine	Special devices required.	Special devices probably required.	May be satisfactory without special devices.	
Slow running	Sensitive.	Less difficult.	Good, but special devices may be required.	
Cruising consumption	Dependent on distribution.		Reduced by good distribution and possibly by stratification.	
Maximum power	Good.	Good.	Favoured by good distribution, but handicapped by lack of charge cooling.	
Simplicity	No continuous mechanical motions.	Mechanical drive usually required.	Delicate mechanically driven components.	
Tuning	When correctly calibrated is reliable.	Probably delicate.	Performed by pump manufacturer, but controls will require test bed tuning.	
Timing	None.	None.	Fairly sensitive.	Not sensitive.
Weight	Normal.	Probably slightly less.	Appreciably heavier.	
Cost	Normal.	Probably slightly more.	Considerably greater.	
Controls!	Complex on modern supercharged engines.		More complex.	

COMMERCIAL AVIATION



"Flight" photograph.

FULL-LOAD TEST. Mr. Geoffrey de Havilland, Junr., takes off the D.H. 95 at an all-up weight of 17,000 lb. The remarkable point about this picture is that the run only started from the Hatfield tarmac, seen in the not-very-far distance.

THE WEEK AT CROYDON

"A. Viator's" Airport Commentary : Czech Service Interruption : Summer Schedules : Enthusiastic Schoolboys

I WONDER what will happen now to C.L.S., the Czechoslovakian Air Company, whose Douglas D.C.3s were a familiar sight at Croydon, and whose personnel were so quietly efficient and popular?

Services to Prague were, of course, suspended on Wednesday of last week, but they say that they will soon be reopened, probably before this gets into print. I can imagine large numbers of people wanting to make use of the Prague-London line, but it is difficult to imagine a rush of traffic from this end to that once delightful city.

Last week's most sensational flight was on Tuesday, March 14, when a K.L.M. Douglas, which had been standing by in Holland on instructions from London, flew to Prague and then made the direct flight Prague-London with a number of passengers. Elaborate precautions were taken at Croydon to prevent Press interviews and photographs, and the tarmac was cleared of stray people. The passengers were rushed through brief formalities and went direct to London. The mystery was deepened when the machine was met by somebody whose hat and umbrella screamed "Whitehall," and who was seen acting "mysterious like" in the main hall and rather giving people to understand that he was a plumber looking for a leaky pipe or something.

All this set the Press inventing things, and one newspaper had it that these were high officials of the Skoda Works bringing all their neatest and newest blue-prints with them. Maybe they were, and, if so, I trust they left some funny drawings behind in easily detected secret drawers in their desks.

On Tuesday, too, there was a liner full of tiny baby refugees, many of them delightful little girls clutching their dolls. They were mostly too young to realise the position, and regarded the air journey as no end of fun. Here, again, the value of an air hostess was amply demonstrated.

Summer services for most of the big air companies have now been announced. Imperial Airways will hand over the Brussels and Budapest services to British Airways, and that firm will also operate the first British service from London to Berlin that has been run for a considerable number of years. Possibly the British Airways service will continue past Berlin to Warsaw.

Imperials schedule eight services each way daily on the London-Paris line, and Air France will operate six times daily each way on the London-Paris route, using the well-known and reliable Bloch. Imperials have allocated the Frobisher class to the Paris run, and most British Airways lines will be run with Lockheed 14s, others being operated by Electras. Imperials also show in their time-table a fast service daily to Switzerland.

K.L.M., together with A.B.A., shows seven departures and seven arrivals daily between England and Holland, most of them being long-distance connections, as, for example, the well-known Scandinavian Air Express linking London with Stockholm.

Not long ago we had a visit from a large number of schoolboys from the Marlborough House School, Hawkhurst, Kent, who were shown round the airport and then flew over London in *Heracles*. Nothing can be more instructive than a flight over London, for, however much one may lose one's way in London on the ground, London from the air is easier to read than any map. All the boys were suitably thrilled, except, perhaps, one Master David Macdonald, who had already flown to Iraq and back five times in the ordinary way of travel between school and his home in Iraq.

Lower-Fourth Critics

There is, as a matter of fact, an increasing interest amongst schoolboys in commercial flying, and I hear of groups of boys who "adopt" Empire flying boats and regularly flag their courses on maps. Burstow School, Gatwick, has adopted an "air cadet" uniform, and Imperial Airways captains are in the habit of giving the boys interesting lectures on civil aviation in its numerous aspects. The idea of the school, which has Gatwick Airport on its doorstep for practical tuition, is to attract increasing numbers of sons of air transport people.

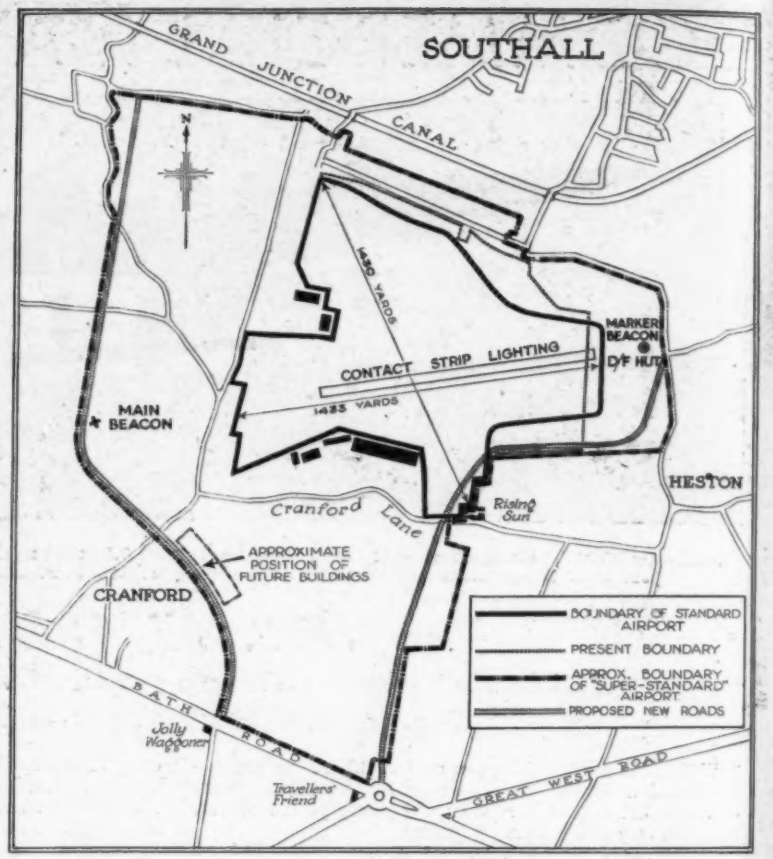
Schoolboys at an airport ask shrewd questions, such as why the authorities are building new hangars if it is true that we are moving away from Croydon within about three years, and, more difficult still, why they did not foresee the development of civil aviation (freely discussed in the lower remove at St. Tipcats ten years or more ago) and build hangars at the right time? Nobody can answer these questions except officials of the Ministry concerned, and you cannot see them for dust on such occasions.

(*Concluded at foot of next page.*)

Commercial Aviation

GREATER HESTON

The Air Ministry's Plans for the Future : Two-Thousand-Yard Runs



Heston as it is at present and as it will be after the series of extensions.

SEVERAL years ago Airwork, when they were in entire control of Heston airport, worked out in considerable detail a plan for the extension of the aerodrome. This involved the taking in of ground to the east, to the west, and nearly as far as the Bath road to the south. The terminal buildings were to be removed from their present position and new ones were to be erected on the northern boundary, where a G.W.R. spur line was to be laid down to feed the airport. If this scheme had been carried out runs of 2,000 to 2,160 yd. would have been available.

As it is, the Air Ministry have bought Heston, and their plans cover very much the same ground. The airport dimensions will, very shortly, have been increased to those of the "standard" airport. New land has already been taken in on the eastern boundary and on the western boundary near the terminal buildings. A considerable amount of land has also been bought in the surrounding areas so that extensions will be made to the east, and very considerable extensions to the west and south.

At the moment the biggest difficulty is that involved in making other arrangements to close Cranford Lane to the south of the aerodrome and the roads adjacent to the western boundary. The closing of these roads will demand a special Act of Parliament, and before they can be closed special new roads must be built to feed the various areas concerned.

The inner marker beacon on the western boundary is being moved back and a permanent D/F hut for "ZZ" approaches is being installed in a new position. The main beacon is to be re-erected some 500 yd. outside the western boundary—a position which has been decided upon as the best for beam shape and radiation reasons; in its present position the equi-signal track is insufficiently stable.

Before the end of April the contact lighting strip should be complete, and, in addition, two experimental lines of approach lights are to be installed at the eastern boundary. One of these lines of what are usually known as threshold lights will be of sodium vapour and the other of mercury vapour lamps. In due course, when tests have been made, it will be decided which is the more satisfactory type of light to retain.

During this summer Heston will be amply large enough for all present purposes and the "super-standard" airport scheme is not likely to appear as an accomplished fact for two years or more. Nevertheless, the scheme is definitely go-ahead and when both this and the Fairlop aerodrome have been completed, Croydon will probably be closed for an indefinite period while large-scale reconstruction work is carried out.

There does not seem to be much chance that very big alterations will be made to the Croydon landing area, though some "corners" will be cut off and the area extended wherever possible. The main thing is to level it and to rebuild the terminal block to suit modern traffic conditions. This work may be started in 1941, but is more likely to remain untouched until 1942.

THE WEEK AT CROYDON

(*Continued from previous page.*)

On Sunday, March 19, a large body of City of London police were seen at the airport surrounding Capt. Lamplugh and Mr. Jeffs. Considerable relief was expressed by friends of these two popular personalities when it was found that it was they who were in charge of the police rather than vice versa. It was a personally conducted tour of an educational nature, arising, one imagines, out of the question, "Should our police know the difference between small aircraft and wild geese flying in the dusk?"

Somebody wrote indignantly to the newspapers the other day to point out that by ordinary means of transport it took a friend of theirs from 6.15 p.m. to 8 p.m. to reach the airport of London, Croydon, from Plaistow, East London, in order to meet a K.L.M. machine which had left Amsterdam at 6.45 p.m. and arrived at 7.40 p.m.

Freight customers often complain that it takes longer to clear a cargo through Customs than it does for the cargo to reach Croydon from one of the nearer Continental capitals. Civil aviation keeps on progressing, but the same cannot be said of Customs and Excise, though even the Airport Customs officials, I believe, would like to see the formalities made a little less eighteenth-century.

Sydney Base Change?

QANTAS EMPIRE AIRWAYS are reported from Australia to be seriously considering leaving their present base at Rose Bay. The facilities there for the servicing and maintenance of the Empire flying-boats are said to be so inadequate that Qantas may transfer to nearby Botany Bay. The company is not apparently anxious to leave Rose Bay and will not if the Federal Government can be persuaded to improve the efficiency of that base.

The hangar now being built will, it appears, be too small to accommodate two Empire flying-boats at the same time, and there is no slipway.

Removal of the entire base may not be necessary. A compromise might be effected by embarking and disembarking the passengers at Rose Bay, and servicing the boats at Botany Bay or elsewhere.

ASSISTING THE BLIND APPROACH

A Sensitive Rate-of-climb Indicator Described : The Cobb-Slater Variometer

UNTIL such a time as radio engineers develop a reliable means by which an approach descent can be regulated, pilots will continue to depend on the indications of a sensitive altimeter when making a blind approach to a terminal airport. In difficult conditions the rate-of-climb indicator, or variometer as the sailplane people describe it, could be extremely useful were it not for the fact that the normal instrument of this type suffers considerably from lag.

What is claimed to be a lagless variometer has recently been produced as a direct development of the instrument which is used in sailplanes, wherein immediate and very accurate indications of up-currents and down-currents are most important. As designed for aeroplane use this variometer, the Cobb-Slater, consists of a vertical block of transparent material with two finely tapered holes bored vertically, each tube containing a small spherical piston. One of these pistons is coloured green to indicate ascent, and the other coloured red to indicate descent, the rates in each case being shown on a scale between the tubes. A small lever at the base of the instrument controls a damper for use in bumpy conditions. The tubes are connected to a reservoir of air contained in two vacuum flasks.

The old type of instrument, operated by a diaphragm and embodying a fixed leak, suffers from considerable drag as well as loss in the transmission of the motion from the diaphragm to the indicator. With a fixed leak, too, inaccuracies must occur over a wide range as, in order to produce sensitivity, a very fine leak is required. Strict accuracy in such instances is only to be obtained if the degree of leak varies directly with the rate of change in ascent or descent.

In the Cobb-Slater variometer the slightest movement of air through the outer tube is registered by the indicator piston, which takes up a position in the tube where the airflow corresponds to the rate of rise or fall; the leakage of air past the indicator is thus automatically and constantly adjusting itself to the variations. When the indicators are both at zero they seat on valve faces. It is this last feature which makes the instrument very sensitive and ensures almost complete absence of lag. When one indicator is showing a maximum rating the leak is such that no pressure is built up in the reservoir, while at rates of ascent or descent greater than the maximum a bypass comes into action to relieve any tendency towards the building-up of pressure. With fixed leak instruments this pressure-building tendency in the reservoir at high readings is marked, with a consequently high degree of lag.

This type of variometer has the additional advantage of simplicity. A number of sensitive variometers have been evolved in the past, but only at the expense of durability. Since there is no mechanism, in the true sense, in the Cobb-Slater device, it should be virtually indestructible.

The type at present in production for aeroplane use covers a rate of change between plus or minus fifteen hundred feet per minute, the lowest graduation being 50 ft./min. This graduation is $\frac{3}{8}$in. from the zero mark, so that, for blind-approach use, rates as low as 20 ft./min. can be gauged.

The Cobb-Slater variometer, which has been tested throughout the winter by Air Dispatch on their Paris newspaper service, has been made by Mr. R. B. Cobb, of Matlock. Enquiries are being handled by Mr. F. W. Griffiths, Air Couriers, Ltd., Airport of London, Croydon, Surrey.

A Cavalier Claim

OF considerable legal interest is the filing of a suit against Imperial Airways (Bermuda), Ltd., by the widow of one of the passengers who lost his life in the accident to *Cavalier* in January. Mrs. K. Miller, who was herself one of the ten rescued passengers, is claiming damages to the extent of £40,000 on the allegation of negligence and misconduct on the part of the crew.

Reform in Australia

IN a report which has recently been discussed by the Australian Federal Cabinet the "reform" of Australian commercial aviation is being strongly urged. This report is the work of an inter-departmental committee which was set up recently by Mr. Thorby in response to criticism.

Its recommendations include an increase in subsidy of £100,000, bringing the total to more than £400,000; the speeding-up of time-tables over certain routes; and the rationalisation of the services to eliminate overlapping. It is pointed out in connection with the latter, for instance, that two highly subsidised companies are operating against an unsubsidised organisation between Sydney and Townsville (Queensland); these two subsidised companies are, in fact, Qantas Empire Airways and W. R. Carpenter, while the unsubsidised services are operated by Airlines of Australia. There is also a duplication of the Sydney-Melbourne route, both Australian National Airways and Ansett Airways running services. A recent attempt by A.N.A. to buy out Ansett resulted in a deadlock.

Scandinavian Additions

THE Scandinavian air transport network is being considerably expanded this year. The Copenhagen-London service, operated by D.D.L., for instance, will be extended to Oslo, the Condors being run through from Copenhagen, via Gothenburg and Kristianssand, and this service will be maintained all the year round. Passengers from Oslo will be able to reach London in less than 6 hours after June 1, when the new schedule is started.

An additional through service will be run by D.N.L., using a chartered Douglas D.C.2, from Oslo, via Kristianssand and Amsterdam, to London. D.D.L. will also run a new service from Kristianssand, via Aalborg, to Copenhagen as from June 1, with a new connection to Hamburg. The ordinary Oslo-Gothenburg-Copenhagen service will be operated by landplanes and also maintained throughout the year. One of the Norwegian Army's new Capronis has been chartered for the night-mail feeder service between Oslo and Gothenburg which starts on April 18.

In Norway, Ju.52 seaplanes will, as before, operate the Oslo-Kristianssand-Stavanger-Haugesund-Bergen daily service, while a daily service will also be run between Bergen and Kirkenes, and a semi-daily service between Bergen, Kirkenes and Tromsö. An application from the private company, Wessels Flyselskap, to open and operate a new direct service between Oslo and Stockholm, using an 8-seater Caproni landplane, has been refused by the Norwegian Government on the ground that safety required the use of seaplanes.

An agreement, as already stated, has been made between Aeroflot and A.B. Aerotransport to resume operation of the Stockholm-Riga-Moscow service, the period being increased from 3 to 6 months. The service opens on May 3 and will be kept going until November 4. The schedule is arranged to connect with Aerotransport's Stockholm-Amsterdam service, which means that the Moscow-London journey may be made in one day. Aerotransport, as well as D.N.L., are both concerned with new Polish expansion schemes. A direct service may be run between Warsaw and Stockholm, and another service from Warsaw via Gdynia and Rönne (isle of Bornholm, Denmark) to Copenhagen.

The Finnish company, Aero, has decided to regularise the experimental Helsinki-Balticum-Berlin service, and intends to add a third daily schedule on the Helsinki-Stockholm run when the company's new F.W. Condor has been delivered. The internal Finnish lines, Helsinki-Tammerfors and Helsinki-Viborg, will be operated daily from May 1 to August 31, and an additional service will be run from Tammerfors, via Vasa-Uleaborg to Kemi between June 15 and August 15. A sub-Arctic airline is being planned to connect Rovaniemi with Lappland. A machine fitted with skis started experimental flights at the beginning of this month. Other forthcoming additions now being considered are a service between Immola and Willmanstrand, and a service from Viborg, via Sordavala, to Joensuu.

Reorganisation in Italy

CONSIDERABLE changes are being made in the internal and external air service network of Ala Littoria and Avio Linee Italiane. The former is to extend its Rome-Haifa service (as already announced in *Flight*) to Baghdad and Basrah, and the Rome-Bucharest line to Constance. New services will be started linking Milan and Budapest, via Vienna, and Brindisi with Bari. The present Venice-Prague service will be substituted by one calling at Trieste and Bratislava.

Avio Linee will no longer fly through to Bucharest on the Turin-Belgrade service, and will make new runs between Turin and Marseilles, Milan and Brussels, and Rome, Budapest, Warsaw and Gdynia. The seasonal internal air lines will also be increased in number. Most of the changes will be made on April 16.

B

COMMERCIAL AVIATION (CONTINUED)

Carlisle Extensions

WITH the appearance of a Royal Air Force Volunteer Reserve training school at Carlisle, something like £80,000 is now to be spent by the Air Ministry on new buildings and equipment at the airport there. This equipment will include D/F radio.

New Equipment for Manchukuo

EARLY this year the Manchuria Aviation Company, which has the monopoly of all commercial aviation in Manchukuo, took delivery of ten Junkers Ju.86s, and some of these should by now have been put in service on the Darien-Mukden-Hsinking-Harbin-Chiammussu line. Previously the company has operated some ancient aeroplanes of the Fokker Universal and similar type, and these are now being replaced by Ju.86s in the larger and B.F.W. 108 Tiafuns in the smaller class.

Polar Service?

MOSCOW correspondents of Finnish newspapers report that Aeroflot has decided to inaugurate "a regular airline from Moscow to New York, via the North Pole," as from April 1 this year. No doubt such plans are in the minds of the Aeroflot chiefs, but the date is too good to be true.

The service, it is said, will be maintained by machines of the new types M.24 and M.25, both of which are equipped with three engines of 1,000 h.p. each and carry 32 passengers in addition to a crew of five.

Colombo Extensions

THE Ceylon Ministry of Communications and Works has now approved a scheme for the extension of Ratmalana aerodrome to the dimensions of the Air Ministry "standard." site. Apart from the acquisition of eighty additional acres of land, D/F and night-lighting equipment are to be installed—mainly for the benefit of Tatas.

Liverpool Goes Nautical

SINCE the local air traffic at Speke, particularly that going across the water to and from Belfast and the Isle of Man, is likely to assume still greater proportions during the summer season, the municipal authorities are interested in the idea of providing some form of rescue organisation in the unlikely circumstances of the descent of one of the machines into the Mersey estuary. The use of a small, flat-bottomed boat is suggested, this to be capable of being hand-launched from the airport boundary at any state of the tide and, more important still, of being slid over the mud banks by two men.

It will, of course, be a very shallow craft, since the Upper Mersey is somewhat tricky and varies from a condition of 80 per cent. mud-bank, intercepted by tortuous shallow channels, to an all-water area at high tide. There are, too, strong ebb and flow currents during the intermediate periods. The suggested boat, when fitted with an outboard motor, would be capable of about seven knots and would carry flotation gear which would be used to keep the unfortunate occupants of any Mersey-bound machine afloat until they could be brought ashore by other methods.

Burma-China

AT the beginning of this month China National Aviation Corporation started a twice-weekly service between Rangoon and Chungking (the company's base), using a Douglas D.C.2. The service stops at Kunming and Lashio, and the entire run of 800 miles is being completed in a single day. The company has ordered two new Douglas D.C.3s, and these should be in service late this summer. The service is being run in co-operation with Imperial Airways who, it is reported, will use A.W. Atalantas—though no confirmation of this fact can be obtained in London.

At the same time it is reported that a new aviation company is being formed in Peiping with the object of reorganising air transport in China. The three Governments which are independent of that of Chang-Kai-Shek, at Peiping, Nanking and of Inner Mongolia, have subscribed the necessary capital, which is supplemented by that from the two companies Dai Nippon Aviation and Hui T'Ung Aviation. The company's headquarters will be Peiping, and services will be operated between Shanghai, Hankow and Canton, and between Peiping, Dairen and Canton. It will actually supersede the existing Hui T'Ung concern.

The Sabena Accident

EARLY on the morning of March 14, a S.A.B.E.N.A. Junkers Ju.52, carrying the night mail from London to Brussels, crashed near the boundary of Haren airport. The pilot, second pilot and radio operator were all killed, and the mail and freight were destroyed. Visibility was reported to be very poor at the time, and it is possible that the pilot made a flying error during the approach. The machine left Croydon at 3.30 a.m.

Pre-heating the Passengers

A WEEK or two ago "A. Viator," in his comments, remarked that A.B. Aerotransport were making use of an electric cabin heater. The idea of this is to warm the passenger cabin before the start of a flight, since, in the ordinary way, the heating system used is dependent on the exhaust and it sometimes takes anything up to quarter of an hour for the interior to reach a comfortable temperature.

During the past month A.B.A. have been using a little 6kW. electric heater with a built-in fan which can be placed at the end of the cabin about quarter of an hour before the machine is due to leave. Needless to say, such an item of equipment is of special value in colder parts of Europe where A.B.A. operate, but even in this country the idea might be worth trying in winter.

An American Approach System

FOLLOWING, in a general way, the lines of that used for blind approach systems in Europe, the Bendix Corporation of America has now perfected transmitting and receiving equipment for its own instrument landing system. In the development of this equipment, which has been carried on during the last three years, one of the main objects has been to reduce the number of component parts to a minimum.

During the various tests the Corporation made use of multi-engined transport aeroplanes and of the services of experienced airline pilots, so that, as far as possible, the equipment finally developed would be that actually required for commercial operations.

Since the present ultra-high-frequency type of approach system used in Europe was originally developed in America, it is interesting to discover that the frequency used in the Bendix equipment is 93.9 megacycles for the main transmitter and 75 megacycles for any ancillary marker transmitters that are used. The system is designed to be independent of such additional aids.

As usual, the basis of the scheme is to provide deformed beams with the aid of a specially designed aerial system. Two beams are used, interlocking in plan form, while each is directed by ground radiation into the customary lozenge shape when viewed horizontally. The aerial system consists of two horizontally polarised arrays excited in phase. The axes of these arrays are in the same horizontal plane, and form an angle of 30 deg. relative to one another. Each consists essentially of a dipole aerial and a series of parasitical excited elements so spaced, and of such a length as to aid forward radiation.

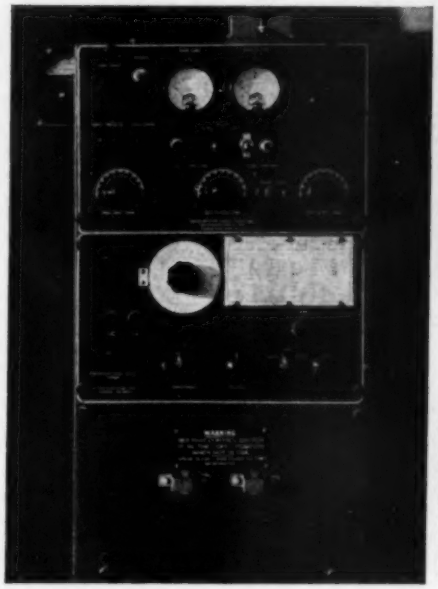
A single receiving set is used, unless marker beacon reception is required, and the transmission is received on a special non-directional loop aerial. The receiver "sorts out" the main radiations from the combined radiation which gives the necessary directional indications. The most interesting item in the receiving equipment is the dashboard indicator, which has two needles, one horizontal and the other vertical. The former gives elevation, and is operated from the energy resulting from the sum of the two space patterns, while the latter gives direction and is operated by the energy resulting from the difference between these patterns.

After tests it was decided that each of the needles should be made to move in representation of the position of the machine relative to the correct course. In other words, if the needles are crossed in the lower right-hand quadrant of the instrument the machine is low and is off-course to the right, while if the needles are crossed in the upper left quadrant the machine is high and to the left of the true course. No reversing mechanism is provided, so that the indications are reversed when the machine is flying away from the main transmitter, over which there is a cone of silence, which gives the pilot a "fix" in space.

Normally, approaches are made from a distance of 6 miles, but useful indications are obtained at a distance of 22 miles when flying at a height of 3,000ft. and of 32 miles when flying at 7,000ft.

ALL-PURPOSE RADIO

The New Hermes Transreceiver Described : Possibilities for the Private Owner



The operating simplicity of the Hermes set is obvious from this view of the control panel. Its size may be gathered from the picture on the right—even if we guess the I.A. operator's height as being more than six feet, the set is still compact.

THE potentialities of the private owner as a radio user have never been very seriously considered. In the first place, a powerful set designed primarily for everyday use in long-range transport machines has been beyond the means of the majority of owners—though, on the other hand, a set designed as an aid to navigation in private aircraft of the smaller type (usually in the form of a homing device) was no use at all to airline operators, and often fell very far short of being a comprehensive radio aid even in its own sphere, owing to the severe limitations imposed upon it by the smallness of the machine. In the second place, the weight of a complete radio equipment has been out of all proportion to the payload available. The prospective users' ideal was obviously a radio set which embraced all the requirements of a dozen different fields and which fulfilled the needs of a dozen different types of private owner.

The owner cannot, as a rule, employ an operator and, consequently, he wants something which he can operate himself, and which at the same time lends itself to easy installation.

There has recently come into the market a new two-way radio set which appears to fulfil the needs of both commercial and private users. It has a performance good enough for the airline operator, yet is within the financial and avoirdupois requirements of the private owner. When the set is not wanted it can easily be removed from the machine. The Hermes lightweight transreceiver, type 1050/51, which is manufactured by Transreceivers of Surbiton, and marketed by General Aircraft, was originally designed for Imperial Airways to their own specification for use on their Empire routes. The first set of this type which was supplied to them maintained contact with Transreceivers' own short-wave station in London over a range of more than 3,000 miles.

The case of the Hermes equipment is divided into three separate compartments, each housing a self-contained unit. At the top is the transmitter unit, in the centre the receiver unit, and in the bottom the power unit. Each is independent of the others, and, if necessary, can be removed merely by uncoupling its respective multipin plug and socket. The whole set can be removed from the machine by withdrawing two steel pins from the shockproof feet on the base, after first disconnecting the power plug from the aircraft battery and, of course, the aerial.

No special fittings are required, and it has not yet been found necessary to fit engine screening harness in addition to the normal bonding demanded by the Air Ministry, the receiver being unsusceptible to local interference provided reasonable care is taken in choosing its position. Power is derived from the ordinary aircraft battery.

The transmitter is designed to work on long, medium or short waves, its actual waverange being from 5 to 1,000 metres. Any desired frequency is crystal-controlled and selected by the push-button method. A limited number of crystals are supplied with the set, the choice of frequencies being governed by requirements; as many as eight crystals can be accommodated in the push-button rack in any order. In normal long-range working it will be found that not more than six different crystals are necessary to cover all radio-controlled areas in the British Isles and Europe.

The tuning of the transmitter, which is always carried out on C.W., is quite straightforward. The crystals for the frequencies covering the work in hand having been previously arranged in some convenient order in the rack, the operator merely pushes the button which corresponds to the frequency he wishes to use. The "oscillator drive" control should be set at approximately half way, and the "send-receive" switch turned to "transmit." The crystal is immediately set in oscillation, which is indicated by a reading on the "amp. grid" meter. The "osc. plate" tuning condenser is then adjusted for a peak reading on the "amp. grid" meter, and then the "osc. drive" control adjusted until this reading is approximately 4-5 milliamps. The key is then depressed, and "A.T.C." adjusted for a dip on the "amp. plate" meter.

Once the set is fundamentally tuned, an operation which can be carried out on the ground, no further attention is necessary. The change from one frequency to another is instantaneous on pushing the appropriate button. A slight adjustment of the A.T.C. might be necessary on making a change, but in all cases communication can be restarted on the new frequency within three seconds of leaving the old one. The time wasted in preliminary exchange of signals to determine one's exact frequency is eliminated.

To transmit on telephony, no retuning is necessary. The transmission selector is merely turned to R.T. position, and the "microphone gain" control fully advanced. The microphone is plugged into its appointed socket on the panel of the set.

When using the ordinary 200ft. trailing aerial the ranges to be expected on long waves under normal conditions are from 150-500 miles, machine to ground, on C.W. telegraphy, and from 150-300 miles machine to ground, on radio telephony and M.C.W. telegraphy. On short waves the ranges obtainable depend, to a large extent, on the factors which govern progagation of these waves, such as the actual wavelengths used and the time of day or night, but, with suitable wavelengths used for prevailing conditions, ranges of from several hundred to several thousand miles can be obtained.

A useful feature incorporated in this equipment is a public address or intercommunication unit. By plugging an external loud-speaker system into the socket marked "intercomm.," the normal operation of the transmitter is cut out and the amplifying side automatically converted into a public-address outfit. By this means the pilot can talk directly to his passengers through a loud speaker in the cabins, or entertain them from a broadcast station by plugging the line into the loud-speaker socket provided on the receiver.

The superhet. receiver covers the same waverange as the transmitter. Accuracy of tuning is obtained by using a pitch control in conjunction with the two-speed tuning condenser. There is automatic volume control, which can be switched in or out, and a separate beat-frequency oscillator for use in

(Concluded on next page.)

receiving C.W. telegraphy. The receiver has dual output, which enables a loud speaker to be used in conjunction with the normal low-resistance headphones. The tuning dial is calibrated in degrees and a calibration chart is provided on the panel of the receiver on which all essential ground stations in three wavebands are logged, provision being made for the addition of any further stations considered useful.

The outside dimensions of the case are 22 by 12 by 9 inches, which, in terms of space, is less than 1¼ cubic feet. The total weight is only 43 lb. (19.5 kilos). The containing case is of aluminium, and all corners are braced and riveted. Ventilation is provided for valve and dynamotor cooling.

The equipment, which has been produced to the specification of Imperial Airways, may be carried as an auxiliary to the standard radio equipment on the Atlantic services during this summer. It may also be adopted for a similar purpose on the long-distance Empire services and for use in the control launches at the various bases.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

HINGED AIRSCREW BLADES

Some Pre-war Experiments

ON page 179 of your issue of February 23 you refer to hinged airscrew blades. It may be of interest to record that such an airscrew was designed by the writer at Farnborough just prior to the war, and was flight-tested on a B.E.2C by Mr. Winfield Smith. The airscrew in question was of metal construction, having three blades. A number of satisfactory flights were made, the airscrew having previously been subjected to a severe spinning test. The idea of hinging the blade was suggested by Mr. F. M. Green. The design was not proceeded with because of the then high cost of metal construction.

Apparently the only difficulty to be anticipated in high-power airscrews of this type lies in the danger that the hinge point may "pick up" or seize, and thus proceed to transmit thrust bending moment as in the normal airscrew. In such a case blade failure would be inevitable. HAROLD BOLAS.

Royal Aero Club, London, W.1.

THE EMPIRE AIR BASE

Claims of Poole Harbour

ARE you aware the Borough of Poole would welcome the setting up in a part of Poole Harbour of an Empire Air Base? The part concerned is Holes Bay.

Holes Bay has only a small entrance from the main part of the harbour, and could be made tideless at hardly any expense. It is well sheltered from winds, but allows, in any case, room for take-offs and landings in all directions. It is, I suppose, four or five miles from the actual sea, and would never require sea walls or anything of such nature. Artificial dykes would not be needed to hold up the water, nor would pumps and so on be necessary.

Poole is only just over two hours by rail from London. There is no shipping in Holes Bay of any moment. In view of the correspondence in *The Times* throwing disfavour on the proposed air base in a disused Sussex harbour, I am sure you will be glad to hear of the keenness of the borough to do everything possible to help. Nobody in Poole would complain.

Finally, the small cost of putting the bay in order for an air base would mean that should big flying boats be out-moded in the future by landplanes, there would not be a large outlay to write off. J. ERIC PUTNAM,

Bournemouth. Director, *Poole and East Dorset Herald.*

ART OR SCIENCE?

An Enquirer Checks Up on Designers' Formulæ

I HAVE read *Flight* almost continually since its inception, and during my spare time I have endeavoured to check-up textbook formulæ with actual commercial productions.

I have tried to compare the respective textbooks with locomotives, machine tools, automobiles and, last, but not least, aeroplanes. There have been disturbing discrepancies between the textbooks and the actual machines as successfully operated, also between the textbooks themselves.

Now, sir, there has recently been published an English book on aeroplane design and the author gives an equation to obtain the dihedral angle.

Checked against fourteen actual machines, the author's "yaw-roll" coefficient is only about 0.450 of that employed on the machines. In other words, had the machines been designed by means of the author's equation, the dihedral would have been about 2¼ times as much as actually employed.

When comparing various formulæ for fin and rudder area, one gets the same disappointing results.

When dealing with stability and control, some authors state that the "whims and fancies" of the particular pilot are taken into account, but, as a mere tyro, I fail to appreciate how this applies, because several of the machines which I have checked will fly hands and feet off.

Am I to conclude that several (apparently) successful machines are all wrong, or is there another logical explanation?

Whilst fully recognising that one cannot expect the arithmetical accuracy usually associated with bank clerks and chemists, I think that it is high time that all the textbooks on a subject should approximately agree with one another.

Again, sir, I have noticed that one or two contributors to *The Aircraft Engineer* have given graphs on which no values of ordinates or abscissæ have been shown. In my opinion, such graphs often spoil an otherwise excellent contribution.

Birmingham. NELSON ROWLAND.

[The answer to the first part of this letter seems to be that aircraft design is still an art rather than a science. The omission of figures on certain graphs may be ascribed to the authors' desire to give qualitative rather than quantitative information. —ED.]

AIR TRAFFIC CONTROL

QBI—And Why the Complication?

READING Mr. Yuill's article in last week's issue, I was more than ever convinced that the whole business of air traffic control is at present in a state of flux.

In the old days the safety of airline passengers was in the hands of a few well-trained and experienced control officers who used their own judgment and common sense in deciding what should be done next. Nowadays, it seems to me, the whole thing should be put on a much more "automatic" basis. With dozens of new control officers in employment by the Air Ministry—many of whom probably have a Civil Service objection to responsibility—and with a steadily increasing number of services and consequently of machines, the time has come to evolve a much more automatic system. The alternative is to offer something resembling a reasonable salary to the control officers so that a much more self-reliant type is encouraged to enter Air Ministry service. Without that type the officers can only be comparable with the staff of railway signal boxes—and the latter have a perfectly straightforward job to do with no doubts about the rightness or wrongness of any particular decision. By way of a start, properly organised layer flying seems to be the immediate solution to the problem.

London, S.W.3. UNCLE REMUS.

A C.A.G. CURIOSITY

Acceptable Fully Qualified—on Not Qualified at All

THE recent correspondence in your columns concerning the Civil Air Guard prompts me to write to you to air my own C.A.G. grouse.

When the scheme was but newly started I applied to a club and on the information gained from that source I applied to join the C.A.G. I was disappointed, however, to be refused because I already held an "A" licence, expired nine months previously. I was told that I could not join the C.A.G. until: (a) I had renewed my licence (involving some dual and three hours' solo flying at ordinary club rates, which I cannot afford); or (b) my licence had been expired two years. The latter means I must wait until after December, 1939.

It seems unreasonable to me that, before I can join the C.A.G. I must wait until I have quite forgotten how to fly.

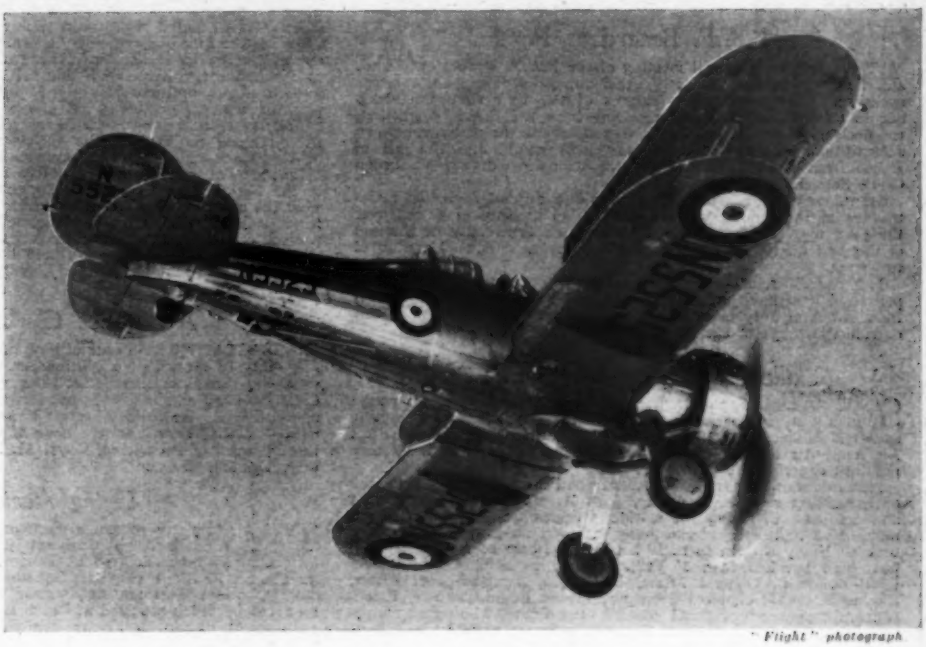
Byfleet, Surrey. G. PARDOE.

In Brief

MR. W. D. CANHAM, of St. Helier, 181, Devonshire Way, Shirley, Surrey, is anxious to enlist membership for the "Shirley Aeronautical Club," which he has founded with the object of arranging visits to airports, inspections of aircraft, etc.

SERVICE AVIATION

Royal Air Force and Official Announcements : Fleet Air Arm News : Military Aviation Abroad



" *Flight* " photograph

SEA WARRIOR : Another view (the first is on page 282) of the Gloster Sea Gladiator which reveals two of its special features. One is the bulge between the undercarriage legs which conceals a dinghy and the other is the deck-landing arrester hook.

Air Ministry Staff Goes to Whitehall

DURING the week-end March 11-12 the Secretary of State for Air, the Parliamentary Under-Secretary of State, the Chief of the Air Staff, together with his Department, and the Permanent Under-Secretary of State, together with the Parliamentary, Press and Publicity Branches of the Secretariat, moved from Adastral House, Kingsway, to the offices in King Charles Street, Whitehall, recently vacated by the Board of Education.

The postal address of the Whitehall building is: Air Ministry, King Charles Street, Whitehall, S.W.1. The telephone number is Abbey 3411.

The removal has been carried out in order that Ministers and the departments of the Air Ministry referred to above may be nearer to Government Departments with which they have to work closely.

The rest of the Air Ministry will remain in the Kingsway area (telephone number: Holborn 3434), and in Berkeley Square House (Grosvenor 4050).

Blind-approach Equipment

IT is reported that a large order has been placed by the British Air Ministry with the American company which manufactures the Air-Track radio blind-approach equipment. From this fact it is to be presumed that difficulty has been experienced in obtaining delivery of the Lorenz transmitters and receivers which have been ordered both for service and for civil use.

The Air-Track scheme is, generally speaking, similar in operation to blind-approach systems used in Europe, and the first installation was completed last year for Pennsylvania Central Airlines. The ground equipment includes a main transmitter and a single marker beacon which is placed at the edge of the runway, but the important feature of the Air-Track system is that it is designed to be portable, the main transmitter being comparatively small in size and mounted on a car trailer. The Air-Track instrument is of the now familiar two-crossed-needle type, the horizontal needle giving relative altitude indications and the vertical needle giving directional indications.

Australian Air Force Tests

THE Royal Australian Air Force is reported to be undertaking a series of reconnaissance flights to sea in which it will be aided by the Australian Navy and British and Australian merchant shipping. Flights of between 200 and 300 miles from shore will be made first and, later in the year, two or more large-scale exercises will be conducted with the Navy. The exercises are based on the fact that, because of the speed of modern ships, it is possible for a vessel some 300 miles off the coast in the evening to be close enough in-shore in the morning to launch attacking aircraft or to make an attack with gunfire on a vulnerable capital city. Constant practice at this aircraft reconnaissance work is necessary in peace-time, especially in Australia, where all the large cities are within gunfire range of the sea. For long, it has been a major function of the Australian Air Force. Extremely accurate navigation is necessary to ensure that the reports of patrolling aircraft are reliable, and to obtain a check in the coming exercises an arrangement has been made with British and Australian ships to report by radio when they sight a reconnaissance machine. They will then give their positions and their reports will be compared with the pilots' logs. Six specialist navigators, who have undergone a long course of training in theory and practice, will take charge of the reconnaissance exercises and instruct pilots in the work of celestial navigation. This is a new departure for Australia, since, up to now, pilots in the Australian Air Force have used only dead reckoning on reconnaissance flights. The flights will be made from Laverton (Vic.), Richmond (N.S.W.), Pearce (W.A.) and, later, from Darwin.

F.A.A. School at Gravesend

OPERATED by Airports, Ltd., a new Elementary and Reserve Flying Training School has been opened at Gravesend airport for the training of personnel for the Fleet Air Arm.

The school started operations on March 6 with sixteen Tiger Moths and nine instructors.

Fleet Air Arm Specialisation

THE Admiralty announces that (A) Branch Officers who volunteer to specialise as Technical Officers will be required to pass a qualifying examination before being allowed to take the specialising course. The examination will be held on Tuesday and Wednesday, April 18 and 19, and will continue to be held in April of each year.

(A) Branch Officers who have transferred from the Royal Air Force and who hold the rank of Lieutenant, may, in certain circumstances, be permitted to specialise without necessarily completing a whole commission on general flying duties.

Unit Badges

HIS MAJESTY THE KING has graciously approved the undermentioned badges and mottoes for the units concerned and they may now be taken into use:—

Unit	Badge	Motto
No. 42 (Torpedo Bomber) Squadron.	On a terrestrial globe the figure of Perseus.	Fortiter in Re.
No. 47 (Bomber) Squadron.	In front of a fountain a demoiselle Crane's head erased.	Nill Nomen Roboris Omen.
No. 59 (Army Co-operation Squadron).	A broken wheel.	Ab Uno Disce Omnes.
No. 63 (Bomber) Squadron.	A dexter arm in bend couped below the elbow grasping in the hand a battle axe.	Pone Nos Ad Hostem.
No. 97 (Bomber) Squadron.	An ogress pierced by an arrow point downwards.	Achieve your aim.
No. 1 Armament Training Station.	In front of a torch a rose.	Altiora Peto.

Long Range Unit Disbanded

THE Long Range Development Unit has been disbanded. Wing Cdr. O. R. Gayford and the other members of the unit have been appointed supernumerary to the R.A.F. station at Upper Heyford.

R.A.F. Benevolent Fund

AT the first 1939 council meeting of the R.A.F. Benevolent Fund, held in London recently, the annual report for 1938 was reviewed. The outstanding features of the year were the sharp rise in expenditure on relief, resulting from the R.A.F. expansion, the decision of serving personnel to support the Fund by voluntary subscriptions of one half-day's pay per annum, and the gift of £3,000 from Lord Wakefield for the expansion of the Vanbrugh Castle School.

Grants expenditure from all branches of the Fund, including maintenance of the school, totalled £22,289, an increase of £2,000 over the year 1937. Although the scheme was started only at the end of the first quarter, subscriptions from serving personnel amounted to £5,113.

The council reluctantly arrived at the conclusion that R.A.F. personnel who have voluntarily transferred to the Royal Navy for Fleet Air Arm duty must be regarded as a Navy responsibility and outside the scope of the R.A.F. Benevolent Fund.

Skilled Men Wanted for F.A.A.

SINCE the beginning of January, this quarter's quota of 350 young men and boys has already entered the Royal Navy for training as Air Mechanics. Recruitment for yet another branch of the Fleet Air Arm—Air Fitter and Air Rigger—is now open, and here some previous experience is necessary.

Particulars of former experience required are interesting, since the opportunity for a Naval career, with its security of employment and prospects of seeing the world, is thus opened to men from a number of trades for whom there has been no place in the Navy before. Entry is open to those between the ages of 17½ and 28 who have had not less than 2½ years' experience as Ground Engineer (civil aviation), General Fitter, Millwright, Jig and Tool Fitter, Engine Fitter, Mechanical Transport Fitter, Engine Turner, Blacksmith, Coppersmith or Metal Worker. Candidates who pass a simple educational test and a practical examination in their trade will be entered as Air Fitters or Air Riggers, according to previous qualifications, and after some eight months' special training will be employed at Naval Air Stations on shore and in H.M. Ships at home and abroad. Air Fitters will be responsible for the upkeep of aircraft engines, and Air Riggers for that of the airframes. On entry they will receive basic pay of 26s. 3d. a week, rising to 63s. and upwards a week as a Chief Petty Officer, with all found, including clothing.

During the first two years of their service promising men will have opportunities of selection for further training with a view to transfer to Air Artificer, a new and highly skilled branch carrying increased responsibilities and considerably higher pay. The basic rates of pay for Air Artificer start at 56s. a week for 4th Class (Petty Officer) rate, and rise to 80s. 6d. a week on advancement to Chief Air Artificer, 1st Class. It is anticipated that some 60 per cent. of Air Fitters and Riggers will eventually be so transferred.

Engagement is for 7 years' active service, followed by 5 years in the Royal Fleet Reserve, or for continuous service of 12 years, with the opportunity of re-engaging for a further 10 years to qualify for a substantial pension on retirement. Owing to the rapid expansion of the Fleet Air Arm, the prospects of advancement in these new branches of the Service should be exceptionally good. Those interested should apply personally, or by letter, to the nearest Royal Naval Recruiting Office.

Apprentice Clerks Wanted

A SUBSTANTIAL number of boys of school certificate or approximately equivalent educational standard will be required to fill vacancies for apprentice clerks. The vacancies will occur in April. Candidates are required to be not less than 15½ years of age and not more than 17½ on April 1 next. The conditions of entry are contained in A.M. Pamphlet 9, a copy of which may be obtained from the Inspector of Recruiting, Royal Air Force, Victory House, Kingsway, London, W.C.2.

Flying Accidents

THE Air Ministry regrets to announce the following accidents:—

Sgt. William Allan Cuthbert (flying solo) lost his life in an accident which occurred at Tangmere, Sussex, on March 13, to an aircraft of No. 1 (Fighter) Squadron, Tangmere.

P/O. Adam Eastman de Pencier (flying solo) lost his life in an accident which occurred at Chesil Beach, Dorset, on March 13, to an aircraft of No. 6 Flying Training School, Little Rissington, Gloucestershire.

Sgt. George Verdun Serjeant (flying solo) lost his life in an accident which occurred near Eryholme, Yorkshire, on March 16, to an aircraft of No. 41 (Fighter) Squadron, Catterick, Yorkshire.

Royal Air Force Gazette

Royal Air Force

General Duties Branch

The following Flight Cadets, having successfully passed through the Royal Air Force College, Cranwell, are granted permanent commissions as Pilot Officers (February 17):—H. J. Winch, P. W. O. Mould.

The following Pilot Officers on probation are confirmed in their appointments on the dates stated:—J. W. Collins (February 19); W. J. Carr, R. E. Drake, M. L. Gaine, W. B. Goddard, H. Ledger, C. Scragg, D. W. Stannard, S. Wroath (February 24).

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers (March 7):—J. W. Appleton, M. G. Arathoon, P. V. Arderne, R. L. C. Axworthy, J. Barraclough, B. S. Bell, D. H. Blomeley, K. F. P. Bond, J. R. D. Braham, R. H. Bunker, A. A. Campbell, J. A. Carmichael, J. Clift, J. R. Cock, F. A. Connolly, D. A. C. Crooks, G. L. Crosby, T. C. Cundill, B. Deaves, P. F. Dingwall, B. B. E. Duff, R. J. Dunlop-Mackenzie, J. F. Evans, N. N. Ezekiel, R. J. Fursman, J. D. W. Gillam, J. D. Goode, P. S. Gordon, A. H. Gould, D. G. Gribble, W. B.-B. H. Griffith, P. Harris, D. E. Hawkins, D. A. Helsby, J. A. Hemingway, E. P. Henley, W. C. Hoey, A. W. Horne, B. F. C. Houston, D. G. Hunter, A. M. Imrie, H. S. James, P. J. Jenkins, K. Jones, J. H. Kennard, K. G. Lamb, H. Lee, B. Lewin, J. Lewis, D. G. Long, W. J. M. Longmore, H. A. Lovell, N. G. Maclarlane, J. D. B. McKenzie, C. C. D. Mackworth, C. A. J. Macnamara, J. F. McPhie, B. A. Martyr, E. M. Mason, F. D. Middleton, A. O. Moffet, E. W. Murray, H. S. Olding, L. J. D. Omissi, R. P. J. Osborne, D. E. T. Osment, R. W. Oxspring, J. F. Painter, A. G. Pascoe, S. R. Peacock-Edwards, S. C. Romer, G. Rowbotham, J. S. A. Russell, W. A. Saunders, D. F. H. Smith, R. T. Sturgess, J. J. Tarlington, K. D'A. Taute, A. A. G. Trueman, J. A. Walker, T. O. Walker, A. Webster, J. E. S. White, S. M. Wickham, B. J. Wicks, L. A. Wood, J. Woodroffe.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation (January 17):—D. L. Cartridge; R. J. B. Renison.

F/O. (A./Flt. Lt.) J. A. G. Gordon is promoted to the rank of Flight Lieutenant with effect from January 22, and with seniority of October 22, 1938. (Substituted for notification in *Gazette* of February 14.)

F/O. (Hon. Flt. Lt.) E. D. Joyce (Captain, R.A.) is promoted to the rank of Flight Lieutenant with effect from February 18, and with seniority of February 18, 1938.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—J. D. Melvin (Acting Flight Lieutenant) (January 27); G. M. Fidler, W. I. Scott (Acting Flight Lieutenant) R. E. Burns, D.F.C. (February 24).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—R. B. Langlois (January 18); R. H. James (January 30); P. A. N. Cox (January 31); A. W. Heward, E. J. Sheeran, M. J. Earle (February 28).

The following Flying Officers are granted the acting rank of Flight Lieutenant on the dates stated:—D. C. Yorke (January 9); P. E. Warcup, M. G. Stevenson (February 1); K. A. Merritt (February 13).

P/O. J. R. S. Romanes is granted the acting rank of Flying Officer (January 1).

The following Flying Officers relinquish the acting rank of Flight Lieutenant on the dates stated:—F. C. Hopcroft (January 1); R. E. X. Mack (February 16).

The following Pilot Officers relinquish the acting rank of Flying Officer on the dates stated:—G. D. Hill (January 25); A. G. Worcester (February 20).

The following Lieutenant Commanders, R.N., are re-attached to the Royal Air Force as Squadron Leaders on the dates stated:—J. H. F. Burroughs (February 27) (seniority January 1, 1936); W. H. G. Saunt (March 6) (seniority September 1, 1938).

Lt. G. Starkey, R.N., Flying Officer, R.A.F., ceases to be attached to the Royal Air Force on return to Naval duty (February 20).

The following are transferred to the Equipment Branch, on probation (January 23):—F/O. J. P. M. Woolley; P/O. P. R. M. Groom.

Flt. Lt. R. R. Gregory is transferred to the Reserve, Class A (March 6).

The following relinquish their short-service commissions on appointment to the Air Branch of the Royal Navy (February 27):—*Flying Officer*: P. W. V. Massy. *Pilot Officers*: E. G. Barrow, L. S. Campbell, P. E. King, A. S. L. Owensmith, O. A. G. Oxley.

The notification in the *Gazette* of February 28 concerning Philip Edmund Warcup is cancelled.

Dental Branch

The following Flight Lieutenants are transferred to the Reserve, Class D (March 9):—I. St. C. Alderdice, L.D.S.; O. F. Brown, L.D.S.

Assistant Provost Marshals

Flt. Lt. C. R. Richdale is promoted to the rank of Squadron Leader (February 23); F/O. W. I. G. Kerby is granted the acting rank of Flight Lieutenant (paid) (February 23).

Erratum

In the *Gazette* of February 28.—For George William de Vincheles le Sheur read George William De Vinchelez Le Sueur.

(CONTINUED)

Princess Mary's Royal Air Force Nursing Service

The following Staff Nurses are confirmed in their appointments on the dates stated:—Miss Elizabeth Agnes Grose (February 2); Miss Dorothy Gertrude Masters (February 8); Miss Winifred Minnie Waller (February 15); Miss Mary Lawson Lownie (February 25).

Royal Air Force Reserve

Reserve of Air Force Officers

General Duties Branch

F/O. D. G. Wilson is granted an honorary commission in Class C as Flying Officer, with the honorary rank of Flight Lieutenant (October 28, 1938); Capt. A. T. Hughes (R.A.R.O.) is granted a commission in Class CC as Flight Lieutenant (December 6, 1938); E. Bradley is granted a commission in Class C as Flying Officer with effect from March 7 and with seniority of February 27, 1932.

Acting Pilot Officer on probation R. L. Jeffery is confirmed in his appointment and graded as Pilot Officer (January 17).

Sqn. Ldr. E. H. D. Spence is transferred from Class A to Class C (March 4); Flt. Lt. W. W. E. Oliver is transferred from Class A to Class C (March 9); F/O. L. W. Lowen is transferred from Class B to Class C (November 15, 1938).

Sqn. Ldr. G. R. Hicks, D.F.C., relinquishes his commission as Flight Lieutenant (Honorary Squadron Leader) in Class CC on completion of service (January 10); Flt. Lt. (Hon. Sqn. Ldr.) G. D. Hill relinquishes his commission on completion of service (January 10); P/O. H. T. W. Blockley resigns his commission (February 18).

Equipment Branch

Capt. A. F. Best, M.C. (R.A.R.O.), is granted a commission in Class CC as Flight Lieutenant (December 8, 1938).

Royal Air Force Volunteer Reserve

General Duties Branch

Maj. W. C. F. A. Wilson, O.B.E. (I.A., Ret.), is appointed Honorary Flight Lieutenant (January 19); Maj.-Gen. D. E. Robertson, C.B., D.S.O. (I.A., Ret.), is appointed Honorary Flight Lieutenant (February 6); Maj. L. C. Mein (Sp. U.L., I.A.) is appointed Honorary Flight Lieutenant (February 2).

H. M. Newton is granted a commission as Pilot Officer (March 14).

Administrative and Special Duties Branch

The following are granted commissions as Pilot Officers on probation (March 7):—C. J. Agelasto, H. Barker, A. H. Barlow, W. H. Bayley, W. H. E. Burton, W. H. Carr-Birkbeck, R. H. Collier, D.S.O., O.B.E., S. V. Cowell, A.F.C., W. N. Craig, W. S. Dailey, G. J. Holdcroft, H. H. G. Lamb, G. H. Lewis, D.F.C., D. Lindsay, G. R. P. Llewellyn, A. McLellan, C. B. Matthews, I. O. Morton, J. W. Paddon, H. M. Parsons, J. R. Pattisson, L. C. Pharoah-Band, D. G. Robinson, J. H. Tyler, M.B.E., E. Walker, D.F.C., A. McC. Wilson, O.B.E., A. B. Yuille, D.F.C.

Medical Branch

The following are granted commissions as Flying Officers (March 14):—T. S. Davies, M.R.C.S., L.R.C.P., I. H. Matheson, M.B., Ch.B., J. Scholefield, M.R.C.S., L.R.C.P.

Auxiliary Air Force

General Duties Branch

Flt. Lt. J. G. Murray (late R.A.F.) is granted a commission in that rank (July 11, 1938).

No. 605 (COUNTY OF WARWICK) SQUADRON.—P/O. J. H. Warren is promoted to the rank of Flying Officer (January 3).

No. 908 (COUNTY OF ESSEX) (BALLOON) SQUADRON.—F/O. J. E. D. Benham is promoted to the rank of Flight Lieutenant (February 6).

No. 909 (COUNTY OF ESSEX) (BALLOON) SQUADRON.—E. S. Horning is granted a commission as Flying Officer (March 1).

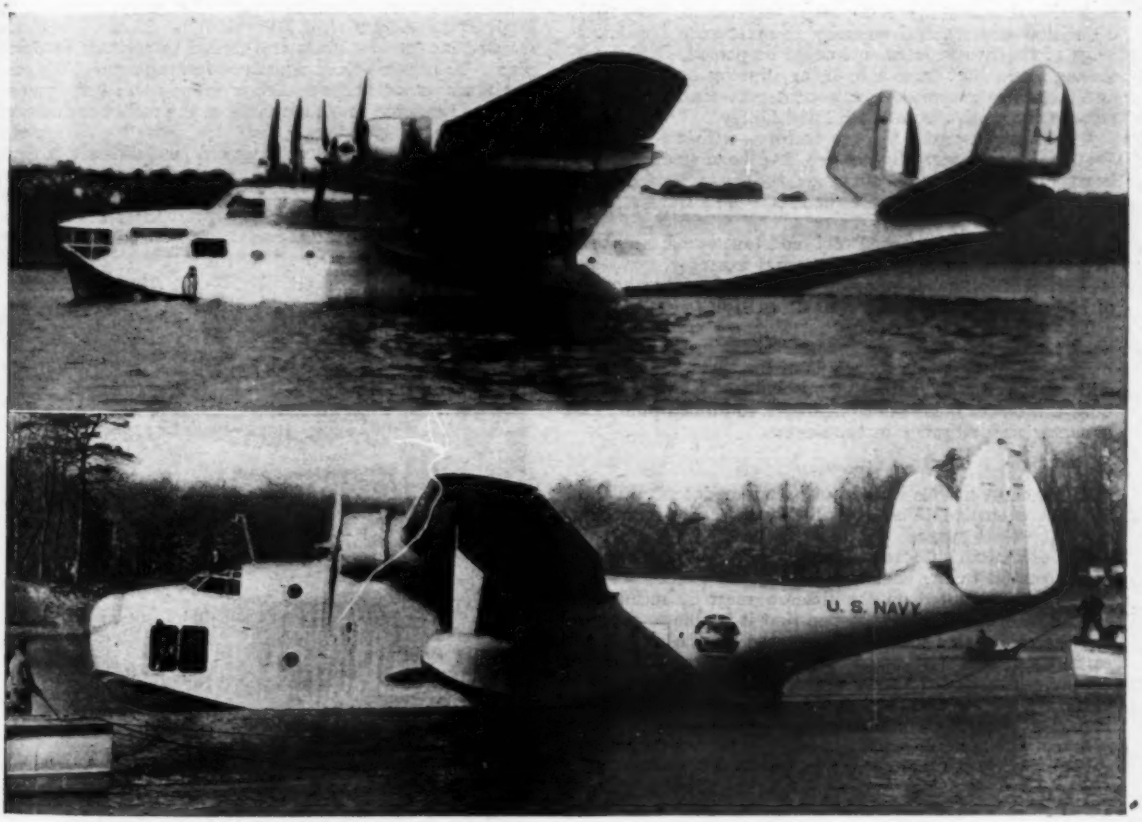
No. 910 (COUNTY OF ESSEX) (BALLOON) SQUADRON.—Sqn. Ldr. A. M. Lyons, K.C., M.P., relinquishes command of the Squadron on being appointed to the General List (February 1). (Substituted for notification in *Gazette* of March 7.)

No. 922 (WEST LANCASHIRE) (BALLOON) SQUADRON.—T. F. Garside is granted a commission as Acting Pilot Officer (February 24).

No. 924 (EAST LANCASHIRE) (BALLOON) SQUADRON.—Capt. A. P. Besley (T.A.) is granted a commission as Squadron Leader and appointed to the command of the Squadron (February 13).

Accountant Branch

No. 616 (SOUTH YORKSHIRE) SQUADRON.—R. Grimshaw is granted a commission as Pilot Officer (January 23).



FLOAT RETRACTION is a feature of both these new military flying boats—the French Latécoère 611 (top) and the Glenn Martin patrol bomber (below). The French boat is fitted with four Gnome Rhone 14 Ns of over 1,000 h.p. each and the American machine, which has a span of 118ft., is believed to have two of the new Wright two-row Cyclones of something like 1,500 h.p. each.

THE ROTOL AIRSCREW

A Detailed Description of a Notable Design Now in Large-scale Production : Manufacturing Methods

(Illustrated with "Flight" Photographs and Drawings)

The visitor to the works of Rotol Airscrews Ltd., at Gloucester, is greeted by this striking frontage of offices.

FOR some time prior to 1936 the research departments of the Bristol Aeroplane Co., Ltd., and Rolls-Royce, Ltd., had been conducting experiments in connection with the developments of constant-speed and other types of controlled-pitch airscrews. In many respects the research work of the two companies was running in similar channels, therefore it was not surprising that in June, 1937, a decision was reached whereby the resources and knowledge of the two departments could be pooled. Rotol Airscrews, Ltd., had come into being, linking both in name and fact the airscrew development departments of the two famous companies from Bristol and Derby.

Within six months a large factory, with an arresting frontage of administrative offices, had been erected in the heart of the Cotswolds alongside the main Cheltenham-Gloucester road and opposite the municipal airport of those two towns.

Serious production of Rotol constant-speed airscrews had started. At the helm, as general manager, was—and is—Mr. R. Stammers, who was for many years a member of Mr. A. H. R. Fedden's staff at Bristol.

To-day production is concentrated on constant-speed airscrews of different sizes. The Rotol airscrew which is being produced at this factory is of the three-bladed type, with the hydraulic actuating mechanism located in the hub, the blades being controlled by a combined pump and governor unit situated on the engine.

The Airscrew Hub

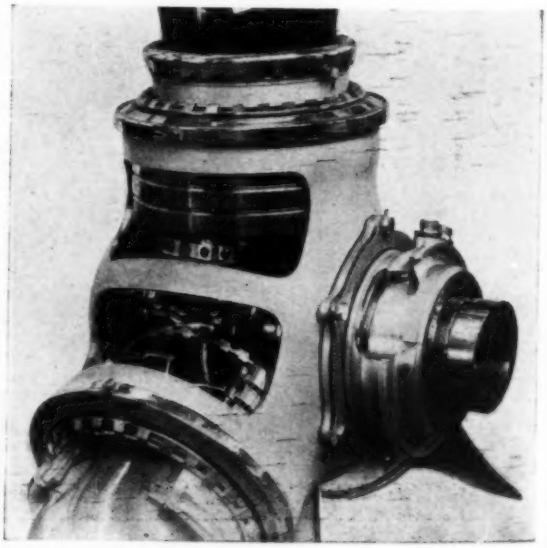
Three short barrels in the hub accommodate the blades, which are carried in stacks of thrust-bearing races that serve the dual purpose of retaining the blades against the action of centrifugal force and at the same time allow them to be rotated in the barrel of the hub for pitch-changing. The hub is mounted on the airscrew shaft by means of a splined sleeve. It is so designed that it is able to counteract the centrifugal force acting on the blades, and at the same time is able to transmit direct to them the engine torque. The forward section of the hub driving centre is of a reduced diameter, and on this neck a stationary piston is fixed. Around the piston is fitted a free cylinder, which is sealed at both ends and is free to slide under oil pressure introduced by the pump unit on one or other side of the piston.

The oil is conducted from the combined pump and governor unit by two pipes which are connected to the airscrew by means of an oil transfer or muff housing at the rear end of the hub driving centre. This housing allows the oil to pass through annular grooves in its bore to ducts in the hub driving centre, which revolves in a floating bush. The oil then passes along these ducts, which lead into the cylinder either in front of or behind the piston. In this way oil pressure applied through one pipe from the governor unit is transmitted through one set of ducts to a particular side of the piston, the oil on the other side of the piston returning through the other set of ducts back to the governing unit. As the oil pressure is applied to one side or the other of the piston so the cylinder is forced to slide forwards or backwards along the hub driving centre.

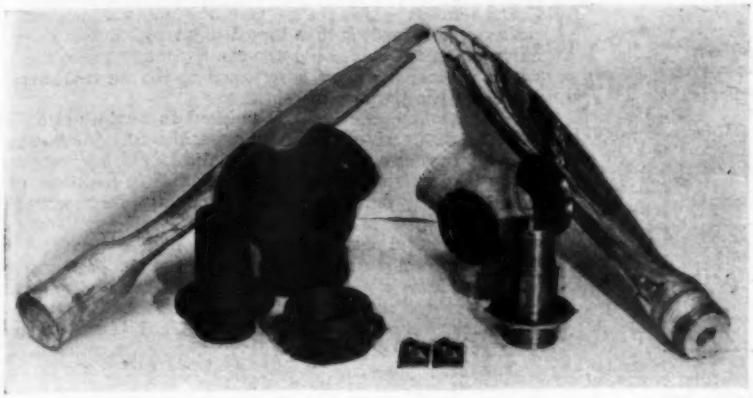
Bolted to the outside circumference of the cylinder are three lugs, into each of which is fitted a sliding bush of Tufnol. It is into this bush that the steel pin attached to each blade root housing is fitted. By this method the longitudinal motion of the cylinder is transformed into a partial rotary movement of the blades.

Fretting Prevented

The blades are of forged magnesium alloy, prepared by High Duty Alloys, Ltd., of Slough. These blades are screwed into steel sockets and locked in position by dowel pins. To prevent the magnesium fretting against the steel at the upper end of the socket, a wedge-shaped section ring of Tufnol is fitted into the mouth of the socket and secured by a locking ring and set screw. Incidentally, the removal of this Tufnol ring in service would be a difficult proposition but for the presence of a wedge-sectioned groove round its circumference. The groove coincides with the position of the set screw of the locking ring. After first slacking off the locking ring, the set screw is replaced with a grease gun nipple, and, with the aid of a grease gun, pressure is



A sectioned Rotol airscrew hub was shown at the recent Paris Show to help visitors to understand the intricacies of the operating mechanism.



On the left are shown an airscrew blade, a hub casing, with a hub driving centre and a number of cylinder lugs (cast in one for convenience). To the right can be seen the finished parts.

brought to bear round the groove of the ring, thus forcing it out of the socket.

Each blade socket is located in stacks of "crowded" ball bearing races, which are in turn mounted in the three short barrels of the hub. There are four main ball races in each hub, with a small pre-loading ball race at the top of each stack. The steel races of the main bearings are so arranged that the inner races tend to contract on to the blade socket by centrifugal force, while the outer races tend to expand against the barrel of the hub. In this way use is made of centrifugal force to secure the blade in its mounting. The small pre-loading race is used to prevent chattering when the centrifugal loads are slight.

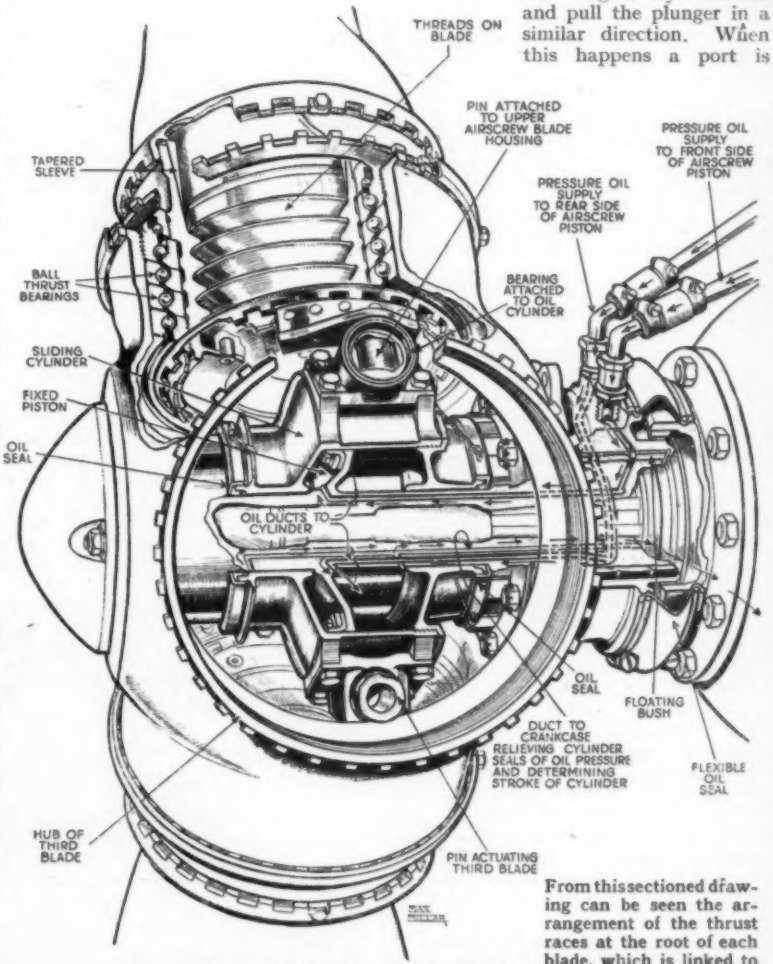
There remains the governor pump unit—the nerve centre of the Rotol airscrew. This light and compact unit can be mounted on any part of an engine where a drive is convenient. It has been so designed that the oil leads may be taken from one side or the other of its casing.

Basically this unit consists of a straightforward high-pressure gear-type pump and a spring-controlled governor. Oil is fed from the engine (at normal pressure) into the hollow and comparatively short idler gear shaft, inside which is a simple reducing valve. From this valve oil is drawn between the teeth of the gears and the chamber in which they are housed.

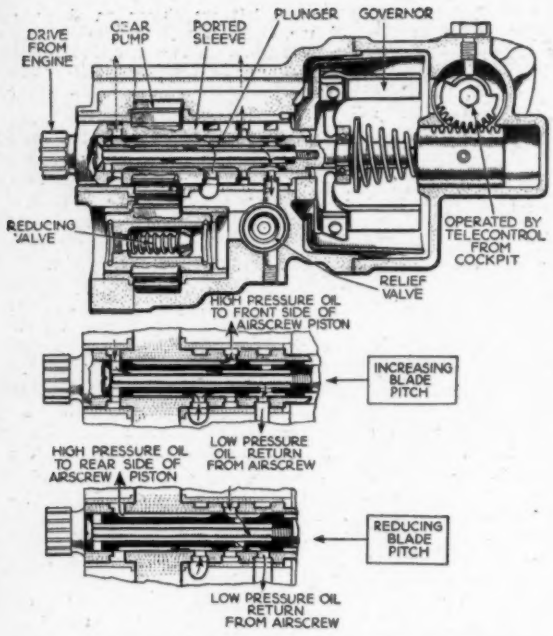
The driving gear of the pump is mounted on a spindle that is somewhat longer than that of the idler gear. The spindle is hollow and sufficiently large in diameter to allow a plunger to slide freely within certain limits. This plunger is in turn hollow and projects out of the back of the gear spindle.

Attached to this plunger is a simple bob-weight governor mechanism. It is spring-controlled, and determines through which outlet the oil pressure generated by the pump shall pass. As the bob-weights of the governor fly out, so the plunger is drawn outwards against a conical coil spring, the tension of which is set at a predetermined pressure by remote control from the cockpit. Similarly, as the engine revolutions fall, so the bob-weights come together and allow the plunger to slide inwards in the shaft of the driving gear. As the plunger slides inside the shaft it opens or closes ports through which oil in one case is supplied to the back or front of the piston in the airscrew hub, while at the same time oil from the other side of the piston is released (at a much lower pressure) through another port opened to a special relief valve via the inside of the plunger.

When the cockpit control has been set for a given number of engine r.p.m. the spring is adjusted to balance any tendency of the governor weights to fly out at that particular speed, and the plunger is in a position in which the ports to the airscrew piston are both closed. Consequently, the cylinder in the airscrew hub is not affected by oil pressure, and remains stationary with the blades in the correct pitch for that engine speed. At this setting oil pressure is by-passed through the relief valve. Any tendency for the engine r.p.m. to increase—as would happen if the machine were put into a gradual dive—immediately exerts a greater force on the governor weights than that which the spring has been set to balance, with the result that the weights fly outward and pull the plunger in a similar direction. When this happens a port is


THREADS ON BLADE
PIN ATTACHED TO UPPER AIRSCREW BLADE HOUSING
PRESSURE OIL SUPPLY TO FRONT SIDE OF AIRSCREW PISTON
TAPERED SLEEVE
PRESSURE OIL SUPPLY TO REAR SIDE OF AIRSCREW PISTON
BALL THRUST BEARINGS
BEARING ATTACHED TO OIL CYLINDER
SLIDING CYLINDER
FIXED PISTON
OIL SEAL
OIL DUCTS TO CYLINDER
OIL SEAL
FLOATING BUSH
DUCT TO CRANKCASE RELIEVING CYLINDER SEALS OF OIL PRESSURE AND DETERMINING STROKE OF CYLINDER
FLEXIBLE OIL SEAL
HUB OF THIRD BLADE
PIN ACTUATING THIRD BLADE

From this sectioned drawing can be seen the arrangement of the thrust races at the root of each blade, which is linked to the operating cylinder. This cylinder slides along the hub driving centre according to whether the oil-pressure is applied through ducts to the back or front of the fixed piston.



The governor-pump unit of the Rotol airscrew incorporates a spring-loaded governor which controls the opening and closing of a number of ports by means of a sliding plunger. The loading of the spring is pre-determined by remote control from the cockpit.

opened and oil is allowed to flow into the coarse-pitch side of the airscrew piston. As the pitch of the blades coarsens, so the load on the engine increases, and the engine r.p.m. drops until the weights in the governor are again balanced by the spring, at which point the plunger is once again back in its central position. The oil is now trapped on both sides of the airscrew piston.

Adaptability

It may be added that the Rotol governor-pump unit has been designed for use with engines rotating in either direction, requiring but the simplest alteration from one-hand rotation to another. The direction of rotation of the pump is changed by reversing a pair of flanged plugs. The operating pressure of this pump is in the neighbourhood of 300 lb., and from this it will be realised that exceptionally fine limits are necessary in the workmanship of the airscrew and governor-pump unit.

And now for a word on production. The Rotol factory is laid out to provide the maximum amount of natural light. High-power G.E.C. "Osira" mercury-vapour-type lamps are fitted throughout the various works departments.

Modern types of machine tool plant are installed throughout the factory; a large number of them consist of special-purpose machines, while some standard machines have been adapted for single-purpose use.

The airscrew blades are received from High Duty Alloys, Ltd., in the form of blanks. The blanks are produced at this company's Slough works in the following manner. The magnesium ingot is removed from the mould, and before it is placed in an electric furnace and soaked for twenty-four hours at 400 degrees Centigrade its casting skin is removed by a machining process. The ingot is then forged to a rough dummy shape between heated dies in a 1,000-ton hydraulic press, during which process the ingot is returned to the furnace several times for the purpose of reheating.

After cooling, the ingot is finished to dummy size. It is then reheated and forged to approximately the finished shape. Incidentally, a test sample is forged integral with every blade as an extension of the tip. In addition, one blade in every batch of twenty is cut up and thoroughly investigated.

At the Rotol works the airscrew blank is centred so that an approximately equal amount of material can be removed from both sides. Three-quarters of the blade from the tip is machined on Berliner contour-milling machines. The root section of the blade is milled on a Sundstrand 3A copy-milling machine.

The next operation is the machining of both trailing and leading edges of the blade. This is carried out simultaneously in a Sundstrand No. 3C Rigidmil. After gauging, certain filing and disc-grinding operations follow. During these operations the blade is attached to an adjustable balance weight. The whole assembly is pivoted at its centre of balance so that the operator can tell whether more metal should be removed, and so is able to keep within the margins permitted.

Blade Balance

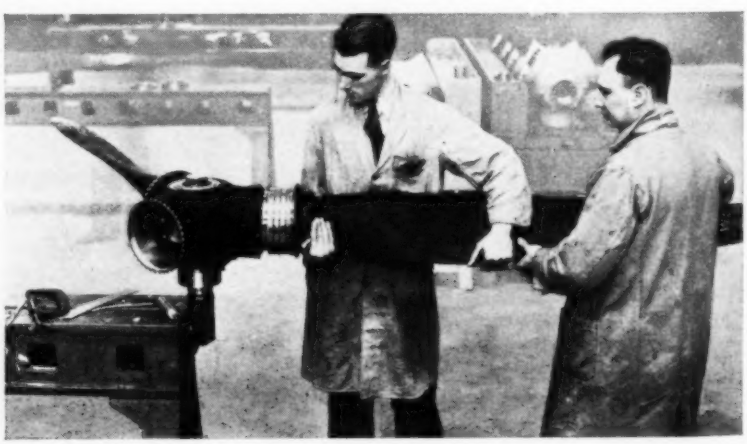
Next, the blade root is threaded and the centre drilled out to enable balance adjustments to be made during final assembly. Finally, the blade is balanced against a master blade in a special draught-proof room set aside for this type of work.

Although there are some 300 components in the hub of the Rotol constant-speed airscrew, the majority do not present any unusual production problems except for the actual hub itself. This part is forged in S.65 and is delivered with the centre pieces bored out. After completion of machining operations the weight is reduced to approximately 42 lb.

The machining operations of this component are divided into three sections—roughing, finishing and final drilling, screwing, etc. The roughing operations are carried out on Webster and Bennett vertical boring machines. In this machine the bore, top face, and a portion of the outside diameter of each barrel are machined. But this is not all, for the internal wall opposite each barrel is of a concave spherical form.

Most of the operations concerned with the machining of the external diameters of the barrels and also the outer convex spherical form of the hub are dealt with by a line of Dean, Smith and Grace lathes. After final roughing on a Cincinnatti vertical milling machine the hubs are subjected to a Magnaflux test for cracks, then they are demagnetised, stabilised, and finally Brinell-tested in the special works laboratories.

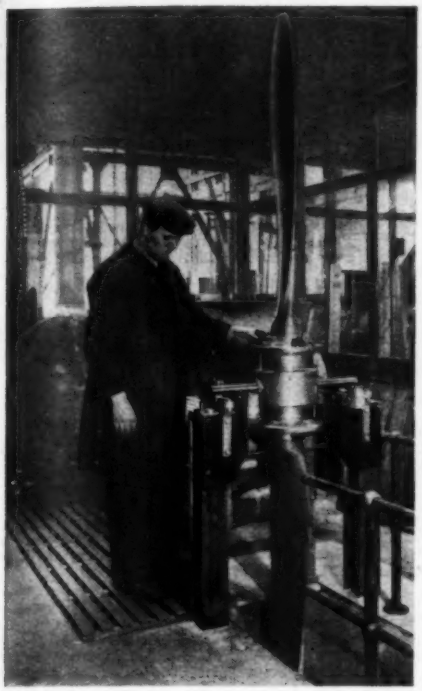
The next group of operations is very similar to that

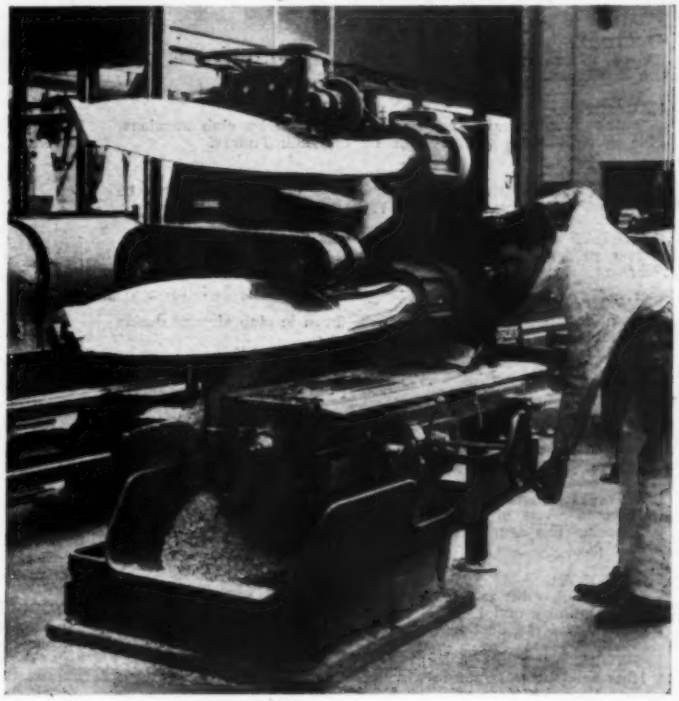


In the final assembly of the Rotol airscrew the blades are fitted into the hub by highly skilled specialists. It is then balanced as a complete unit prior to packing for delivery.

already described, but they are concerned with the machining down to the final dimensions.

As has been already mentioned, the other components of the hub—and, for that matter, the governor-pump unit—call for nothing unusual in the way of production methods except the latter is subjected to a series of rigorous tests. Orthodox machining operations are employed throughout, and the finished product stands out as an example of superb workmanship and design, as is to be expected from the two firms which the name of Rotol links.





(Left) Each blade is carefully balanced, in special draught-proof shops, against a master blade. (Right) "Copying" both faces of the blade root from a master on a Sundstrand Rigidmil.

CARBURETTER or INJECTION?

(*Concluded from page 290*)

"Such evidence as is available in connection with multi-cylinder engines indicates no improvement in either power or consumption compared with the carburetter system, nor is there any good reason to expect more from the same cylinder compression ratio assuming good distribution with the existing system.

"With a supercharged engine, the volumetric efficiency might conceivably be reduced unless the cooling effects of the fuel inside the cylinder during the charging stroke contracts the volume of residual gases. Claims are made of higher powers being obtained from single cylinder tests. Those who are familiar with single cylinder research with carburetter systems will appreciate the large variation in power and consumption obtainable by ringing the changes of valve timing and induction and exhaust pipe ramming effects. Experience, however, shows that these cannot be transferred to a supercharged multi-cylinder engine where common induction and exhaust manifolds are esssential.

"For this reason the authors would say there is very little to be gained by the way of improvement in volumetric efficiency due to a change in timing to suit fuel injection, if the same simplicity of pipe layout is to be maintained. As regards consumption, the lowest theoretically possible figures have been approached on a carburetter engine having a good distribution system; these are not likely to be improved with the introduction of fuel injection, and though it may be found possible to run on ultra-weak mixtures with stratified charges, with the latter system specially designed combustion chambers would be necessary and consideration of these has been outside the scope of this paper.

"The layout of a fuel injection system requires considerable care, involving as it does a number of mechanical moving parts and a complicated system of controls. It is essential also that the fuel feed pipes are all of equal length to ensure an equal discharge at each nozzle, although in practice individual adjustment of the nozzle valves may be necessary to obtain an equal mixture strength in each cylinder if the volumetric efficiency of the cylinders is not the same.

"On a carburetter system the correct ratio of fuel and air is obtained, to a large extent, by suitable proportioning of the chokes and jets, with automatic devices to give the corrections for altitude and special conditions outside the cruising range. The carburetter, however, requires the added complications of special precautions against freezing in the form of passages and piping to carry the heating medium. Cost and weight are both largely dependent on simplicity and a fuel injection system is certainly heavier and more costly than the corresponding carburetter system. The fine limits involved in the moving parts in an injection pump mean careful manufacture, and frequent servicing may be necessary to maintain the accurate metering claimed for this system.

"Many hours' development and flying have been carried out on fuel injection, but there is not, at present, the same experience that has been obtained on carburetters of all types and the undoubted possibilities of fuel injection have yet to be developed fully."

NEXT WEEK: FLIGHT BRITISH AND FOREIGN MILITARY AIRCRAFT NUMBER

FROM the CLUBS and SCHOOLS

REDHILL.
MR. G. KONREID has passed his "A" licence test, while Mr. H. Johnston has gone solo. 68 hr. 50 min. were flown last week.

ABERDEEN.
Over 28 hr. were flown by C.A.G. members last week. New C.A.G. premises will be available shortly.

KARACHI.
During February 219 hr. 40 min. were flown by club members. This figure includes 5 hr. 25 min. on the Link Trainer.

BORDER.
An improvement in weather conditions enabled 52 hr. to be flown during the week. Mr. R. T. Carnegie went solo.

HYDERABAD.
Over 79 hr. were flown in club machines during the month of February. Lt. Dilip Chandhuri has joined as a new member.

PLYMOUTH.
In spite of bad weather, 26 hr. were flown in club aircraft during the week ending March 14.

THANET.
For the week ending March 14 73 hr. were logged in club aircraft. Mr. J. Rootes made his first solo flight.

WESTON.
Over 66 hr. were flown in club machines during the week ending March 14. Mr. W. S. Cooke has gone solo.

NORWICH
Three members of the C.A.G. completed their first solo flights last week. The next lecture for Class II members will be held on March 30.

HANWORTH.
Last week 154 hr. 30 min. were logged. Messrs. S. M. Farrington, W. C. Stanbury and I. H. McAlister-Gunn have gone solo. Seven members have qualified for "A" licences.

IPSWICH.
High winds were responsible for reducing flying time for the week ending March 14 to 32 hr. The C.A.G. will hold a supper-dance on March 24 at the Great White House.

NORTHAMPTONSHIRE.
At the recent annual general meeting Major G. R. D. Shaw was elected president on the retirement of Lord Willoughby de Broke. Mr. E. Bignall has gone solo.

CINQUE PORTS.
The total flying time for last week amounted to 43 hr. Mr. J. L. Melville has passed his "A" licence test, while three C.A.G. members have gone solo.

WEST SUFFOLK.
Bad weather reduced flying time to 15 hr. Decorations to the new clubhouse are almost complete, and it is hoped to hold the opening ceremony during the week.

BEDFORD.
Twelve newcomers have recently joined the School, while three members, Messrs. R. H. H. Kemp, W. H. C. Davies, W. S. Bull and A. R. B. Chambers have gone solo.

BRISTOL.
Week-end flying for C.A.G. members has been reduced to 5s. an hour. Messrs. C. F. Stubbs and R. A. Wood have gone solo. Last week 42 hr. 40 min. were flown by the club.

EXETER.
During the week ending March 14, 39 hr. 30 min. were flown. Miss Kent, Messrs G. Pridham and R. Hosking have qualified for "A" licences, while Miss C. Power, Messrs. H. M. Armstrong and F. R. F. Daw have gone solo.

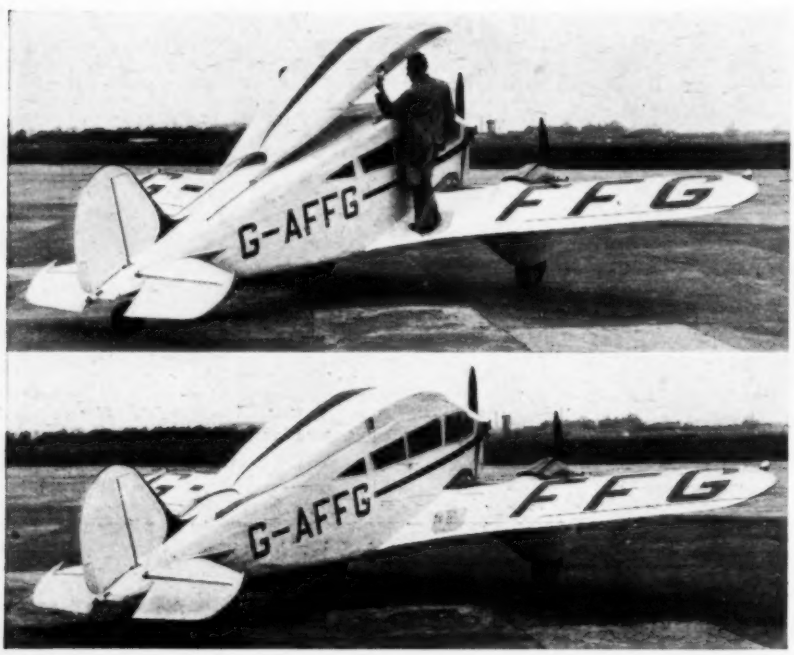
SOUTH COAST.
Miss C. F. Bradford and Mr. J. F. N. Amis have qualified for their "A" licences. C.A.G. applicants are requested to obtain Ministry of Labour clearances so that further members may be enrolled. 30 hr. were flown last week.

BROOKLANDS.
The date for the club's annual at-home and garden party has been fixed for June 10. Next Sunday there will be a map-reading contest. Last week 95 hr. 10 min. were flown. Mr. S. Simpson went solo, while Mr. J. Machin won a landing competition.

YORKSHIRE.
During the past week 112 hr. 15 min. flying time was put in on club machines. The Misses M. E. Oakley, E. Blackburn, M. Greatorex and G. M. Brooke, and Messrs. P. M. Sims, M. J. D. Akam, N. Jones and R. Lodge have all gone solo.

ROMFORD.
Flying at Chigwell aerodrome was limited to 65 hr. by the weather, but the Misses B. Lyall and Lane, of the N.W.A.R., were able to make their first solo flights. No. 6 (Romford) Squadron of the A.D.C.C. are to build their own glider at Maylands Aerodrome, Romford.

RAND
The Rand Flying Club has originated a scheme whereby an "A" licence may be obtained for £25. Two new Aeronca Chiefs have been purchased, and pending their delivery inexpensive training is already being carried out on Gipsy Moths. January's flying total was 283 hr. 14 min., and Mr. C. J. Charlton obtained his "A" licence. In the gliding section 107 flights were made and a total of 6 hr. 10 min. recorded. The new postal address of the Rand Flying Club is "Rand Airport, Germiston," and not "P.O. Box No. 2768," as previously.



VARIABLE LIFT: Two views of the Helmy monoplane, some details of which were given in last week's issue. Above (on the left) the fuselage lifting section is shown free of the fuselage proper, while, below, the machine is shown in normal trim. Mr. F. Helmy, the designer of the machine, is seen above.

MINOR TO MAJOR: The new Luton Major two-seater flying at its home aerodrome at Denham. With a Walter Mikron engine, the machine has a top speed of about 105 m.p.h. and a landing speed of 30 m.p.h. From the club point of view one of the machine's advantages is that the wings fold. The test flying has been largely carried out by Sq. Ldr. E. R. Mole, of gliding fame

PORTSMOUTH.
Over 134 hr. were flown during the first eighteen days of March, of which 51 hr. were flown by C.A.G. members. Eighteen C.A.G. members have passed their "A" licence tests.

DONCASTER.
Over 37 hr. were flown last week in club aircraft. Mr. O. H. Gutekonst has joined as an assistant instructor. Mr. J. Prescott has gone solo. On March 30 the C.A.G. members are holding a dance.

EASTBOURNE.
Strong winds and rain held up flying during the past two weeks, when 59 hr. were logged. A goodwill luncheon was held on March 12, when 19 machines arrived from Brooklands and Shoreham.

PENANG
During December cross-country flights to other Malayan aerodromes were undertaken by club pilots, and 87 hr. 20 min. were flown. Five Vildebeests belonging to No. 36 Squadron dropped in from Singapore, and Mr. Matthew, from Calcutta, halted at Penang on his journey to Singapore.

LONDON.
Last week, when 92 hr. 35 min. flying time was logged, Miss M. Davies, Messrs. C. M. Beavis, W. J. Corbet, C. Humphreys and H. C. Lawrence made their first solo flights. Mrs. Irwin, Miss J. Miller and Messrs. C. M. Beavis and J. M. Jennings have completed their "A" licence tests. Mr. I. H. Kestin is taking an instructor's course.

YAPTON.
Total flying time for the first eighteen days of this month amounted to 72 hr., of which 16 hr. were put in by club machines. Five C.A.G. members have qualified for their "A" licences.

BENGAL.
The Bengal Flying Club sent two machines to the air display at Alipore in aid of St. Mary's Home and the Dufferin Hospital. About eighteen machines took part and the display lasted until dusk. Unfortunately, on the return journey the assistant aerodrome officer's machine developed engine trouble and was wrecked in the resultant forced landing. Luckily, the three passengers and the pilot are well on their way to recovery. A privately owned Hornet Moth and the Fox Moth flew over to Calcutta to drop "bombs" on a specially constructed village on the Maidan. Flying times were 97 hours for the month of January.

BOMBAY.
The flying time for the month of February was 202 hr. 22 min., of which 1 hr. 10 min. was night flying. This shows an increase of 73 hours over the total for February, 1938. Mr. S. Ejel and Mr. M. C. C. Turner made their first solos, and Mr. Ejel has since completed the tests for his "A" licence.

The annual gymkhana of the Bombay Flying Club was held on the 26th, when a large crowd attended. A free bombing competition was held among the club members, and Prince Daljit Singhji of Idar was declared the winner. It was at this display, we regret to say, that the chief instructor, Mr. B. B. Nicholson, who was giving a display of aerobatics, crashed and unfortunately succumbed to his injuries.

A PERCIVAL TRAINER

ALTHOUGH no examples of the machine have yet been built, the characteristics of the Percival monoplane *ab initio* trainer are worthy of mention.

Structurally the machine follows standard Percival practice, the wing having two box spars with bulkheads and spruce strut diagonals, the contour being formed by wooden ribs and the leading edge reinforced by plywood. The flaps are of metal.

Spruce longerons, plywood sides, and plywood decking reinforced in the region of the cockpits characterise the fuselage. The cockpits have a quick-release door on each side. The rear frame of the windscreen is a steel tube which picks up a steel hoop in the decking. These two hoops form strong points to take the shock should the machine overturn on the ground.

Incorporating a patented self-centralising device, the tail wheel is completely rotatable and has a self-lubricating bearing. Each unit of the wide-track undercarriage consists of a cantilever compression leg incorporating steel springs and a hydraulic recoil damper.

The Gipsy Six Series II engine is fitted as standard, being mounted on tubular steel bearers with special rubber housings to absorb vibration. Fuel is carried in tanks in the root ends of the outer wings and the oil tank is in the leading edge of the centre section, being cooled by air ducts in the leading edge. Either a Schwarz-covered fixed-pitch wooden airscrew or a De Havilland constant-speed type may be fitted.

The tandem cockpits have complete dual controls, the rudder bars having an adjustment range of 6in. Either bar may be easily disconnected before flight. The seats have a four-inch vertical adjustment, operation being by means of a lever on the starboard side of the seat. A collapsible blind-flying hood is fitted to the front cockpit. The machine can be flown solo from either cockpit without the addition of ballast.

The aerofoil section used in the Percival C.20 gives a high lift and low drag combination with an almost stationary centre of pressure over and above the normal range. The section varies along the span by a reduction in thickness and chord towards the tip.

Data for the Percival Trainer are: Span, 36ft.; length, 26ft. 5in.; tare weight, 1,710 lb.; gross weight, 2,500 lb.; top speed, 163 m.p.h.; rate of climb at sea level, 1,400ft./min.; take-off run (no wind), 220 yards; range at cruising speed, 600 miles. These performances are for the machine as fitted with a constant-speed airscrew.

Midland Gliding Camps

DURING this summer season four camps will be held by the Midland Gliding Club at Longmynd. The first will be at Easter (April 7-15), the second at Whitsun (May 27-June 4), the third from August 5 to 13, and the fourth will be a public schools' camp later in that month (August 19-27).

The pupils of each camp will be limited to twenty-four and the maximum payment for the full period of each will be eight guineas—with reductions for private owners and members, and for shorter periods of stay. The Midland Club has five soaring machines as well as a dual two-seater. Those interested should write to Mr. R. N. Thwaite, the camp secretary, at 39, Silhill Hall Road, Solihull, Birmingham. A reservation fee of one guinea must be sent with any application.

THE ROYAL AERO CLUB

News and Official Notices for the Week Ended March 18

The King's Cup, 1939

HIS MAJESTY THE KING has given his approval to the running of the King's Cup Air Race for 1939 according to an entirely new formula, which will establish it as the most remarkable air contest yet devised.

Pilots' skill, high speed, unlimited power, concerning quickness, and the calculations of the handicappers will form the pieces in a novel game of "Handicapper's Halma," which will be played at a leading provincial airport early in September. No limit is placed upon the horse-power of the engines fitted to the aircraft taking part, but the lowest handicapping speed will be 140 m.p.h. The race will be divided into four sections, each consisting of five laps of 20 miles, making a total distance for the course of 400 miles.

Between each section the competitors will be re-handicapped, the performance during the previous section being used as the basis. In order to prevent "pulling," penalties will be imposed for any unexplained variations in speed. Marks will be given for the winner and those placed in each section, and the aircraft gaining the most marks in all four sections will be the winner. Aircraft and engines must be of British manufacture.

In addition to the Cup presented by His Majesty, the winner of the race will receive a cash prize, and there will be additional cash prizes for those placed second and third. There will also be prizes for the competitor placed first in each of the four sections and a special prize for the fastest time. All cash prizes, which reach a total of £1,000, have been presented by Viscount Wakefield of Hythe.

Wakefield Challenge Trophy Race

INTERLEAVED between the sections of the King's Cup Race will be the three corresponding sections in the race for light aeroplanes, which has already been announced in these columns. The name of this event is to be the Wakefield Challenge Trophy Air Race. In this case, as in the one just mentioned, Lord Wakefield is providing the cash prizes. The method of running and handicapping this race will be similar to that for the King's Cup. The minimum handicap speed of the light aeroplanes will be 85 m.p.h.

The handicappers for both the above races will be Captain W. Dancy and Mr. F. W. Rowarth. The detailed regulations for both the King's Cup and Wakefield Challenge Trophy races will be published later.

Royal Aero Club Administration

A SERIES of new names put forward by members of the Royal Aero Club has necessitated a ballot for the nine vacancies on The Committee of the Club. For some years the retiring members have been elected. This year thirteen members have been nominated. The voting will be carried out by postal ballot, and lists showing the composition of The Committee and of the Sub-Committees, together with the attendances of the past year, will be sent out with the voting forms. The following eight retiring members offered themselves for re-election :—

A. J. A. Wallace Barr; Cdr. James Bird, O.B.E.; Flt. Lt. C. Clarkson; Capt. A. G. Lamplugh; Lt. Col. Sir Francis K. McClean, A.F.C.; Capt. R. L. Preston; Major J. Stewart, O.B.E.; G. H. Wilson-Fox.

The five new nominations are: Capt. H. S. Broad; Richard Ince; J. S. Newall; Dr. A. P. Thurston; P. A. Wills.

C.A.G. Hitch

ONEROUS conditions have been laid down by the Air Ministry limiting the distribution of profit earned by aeroplane clubs operating the C.A.G. Severe criticism was launched at these conditions by representatives of some forty clubs at a meeting of the General Council of Associated Light Aeroplane Clubs held at the Royal Aero Club, and it was stated that these conditions might seriously endanger the future of the scheme. The Air Ministry limits the distribution to 5 per cent. in any one year. This is considered to be a figure so low as to preclude the clubs from obtaining the finance necessary for the purchase of equipment. The clubs were unanimous that the Air Ministry should be approached again on the matter.

The development of the C.A.G. scheme to give extra flying to "starred" members has already been agreed upon, and for this many clubs will be requiring additional aircraft. Apart from the development, the clubs find at the present time they are still short of aircraft in order to operate the scheme in a successful manner. The Air Ministry has been approached by the Executive Committee of the General Council with proposals that the clubs should be assisted with finance in order to meet the situation. Proposals envisaged an advance from the Ministry of £250 per aircraft acquired since the announcement of the C.A.G. scheme, and the clubs were quite willing for the repayment to be made to the Treasury on an agreed basis spread over the period of the C.A.G. subsidy scheme.

Aviators' Certificates

No.	Name	Club or School	Date
17,284	Frederick George Shaw Wilson	Hampshire Aeroplane Club	8.3.39
17,285	John Bernard Hancock	Northern Aviation Club	6.3.39
17,286	Frederick Charles Dafforn	Southend Flying Club	2.3.39
17,287	Ronald Gordon Lintott	Southend Flying Club	2.3.39
17,288	Claude Beary Savory	University Aero Club	20.2.39
17,289	Antony Gerald Brownsill	University Aero Club	20.2.39
17,290	Michael Edward Hallam	University Aero Club	9.2.39
17,291	Yvonne Kathleen Newman	Bedford Aero Club	9.3.39
17,292	Ronald Arthur Palmer	Bedford Aero Club	9.3.39
17,293	Noel Primrose Anson	Bedford Aero Club	9.3.39
17,294	Margery Bertha Grimmer	Bedford Aero Club	9.3.39
17,295	Dorothy Phyllis Wilson	Eastbourne Flying Club	21.2.39
17,296	Frederick Geoffrey Harrison Wall	Newcastle-on-Tyne Aero Club.	10.3.39
17,297	Frederick George Smith	Herts and Essex Aero Club	9.3.39
17,298	Neville Frederick Jordan	Bedford Aero Club	10.3.39
17,299	Tom Hurst	Thanet Aero Club	10.3.39
17,300	Peter Anthony Major	Thanet Aero Club	10.3.39
17,301	Maurice Robert Lacy	Reading Aero Club	11.2.39
17,302	Archibald Norman MacConnell	Reading Aero Club	14.2.39
17,303	Oswald Cyril Chambers	Reading Aero Club	1.3.39
17,304	Paul Lailey Uphill	Reading Aero Club	1.3.39
17,305	Cecil Thompson	Edinburgh Flying Club	12.2.39
17,306	Henry Stockley Brown	Bournemouth Flying Club	11.3.39
17,307	Gerald Theodore Lydford	Bournemouth Flying Club	10.3.39
17,308	Norman Augustus Geer	Bournemouth Flying Club	11.3.39
17,309	Norman Colton Cragg	Herts and Essex Aero Club	26.2.39
17,310	Raymond George Bruton	London Aeroplane Club	11.3.39
17,311	Francis Stanhope Homersham	No. 30 E. and R.F.T.S. Derby.	25.2.39
17,312	Jack Jackman	No. 17 E. and R.F.T.S. Barton, Manchester.	11.3.39
17,313	Charles Joseph Thomas Gardner	Redhill Flying Club	5.3.39
17,314	John Charles Heyworth Mercer	Malling Aero Club	24.2.39
17,315	Edward Solomon Hymans	Malling Aero Club	11.3.39
17,316	Robert Holden	Lancashire Aero Club	3.3.39
17,317	Sidney James Last	Southend Flying Club	12.3.39
17,318	Jean McIntyre Weeks	Romford Flying Club	9.3.39
17,319	Lewis John Plumstead	Cambridge Aero Club	10.3.39
17,320	Thomas Quintin Osburne	West Suffolk Aero Club	10.3.39
17,321	Alan William George Woodford	Hampshire Aeroplane Club	12.3.39
17,322	Margaret Lilias Stirling	Hampshire Aeroplane Club	12.3.39
17,323	Penelope Anne Mary Smith-Rewse.	Hampshire Aeroplane Club	10.3.39
17,324	James Emrys Gwynne Johns	Bournemouth Flying Club	4.3.39
17,325	John Basil Fenwick	Grimsby Aero Club	13.3.39
17,326	Alfred Cleaver	County Flying Club	11.3.39
17,327	Horace Adcock	Worcester Flying Club	9.3.39
17,328	Dennis Frederick Woods	Southend Flying Club	12.3.39
17,329	Eric Frank Edsall	Southend Flying Club	17.2.39
17,330	Ernest Henry Christopher Pearmund.	Southend Flying Club	2.3.39
17,331	Edwin Arthur Boyes	Yorkshire Aeroplane Club	12.3.39
17,332	James Fairley Swan	Scottish Flying Club	11.3.39
17,333	Duncan Menzies Masson	London Aeroplane Club	3.3.39
17,334	Gerald Percival Rudston	Hull Aero Club	10.3.39
17,335	Ernest Magnin	Hull Aero Club	9.3.39
17,336	Richard Reginald Jordan	Exeter Aero Club	6.3.39
17,337	Ronald Edwin James Hill	Tollerton Aero Club	9.2.39
17,338	David Johnston	Northern Aviation Club	4.2.39
17,339	Jesse Heitner	Brooklands Flying Club	25.2.39
17,340	Frederick James Golightly	Liverpool and District Aero Club.	17.2.39
17,341	John Henry Ballard	Thanet Aero Club	13.3.39
17,342	James Longmuir Hamilton	Scottish Flying Club	13.3.39
17,343	Alfred Ernest Firmin	Norfolk and Norwich Aero Club.	12.3.39
17,344	Thomas Graham	Cardiff Aeroplane Club	26.2.39
17,345	John Probert Eskdale	Newcastle Aero Club	13.3.39
17,346	Matthew Kenneth Mann	Yorkshire Aeroplane Club	12.3.39
17,347	James Wenman Wykeham	Kent Flying Club	19.3.39
17,348	Francis Hawthorn Ashdown	Southend Flying Club	13.3.39
17,349	Kenneth Lloyd Collinson	Thanet Aero Club	10.3.39
17,350	David Beaton Lindsay	Strathtay Aero Club	1.3.39
17,351	John Gordon McEwan	Edinburgh Flying Club	3.3.39
17,352	Ernest Harold Hall	County Flying Club	13.3.39
17,353	Rupert Henry Gratton-Doyle	London Aeroplane Club	13.3.39
17,354	Ivor Albert William Bowman	South Coast Flying Club	12.3.39
17,355	Corinne Munro Mackenzie	South Coast Flying Club	12.3.39
17,356	Nazan Lucille Haddock	South Coast Flying Club	12.3.39
17,357	Arthur Hallock	Hampshire Aeroplane Club	16.3.39
17,358	Lindsay Hugh McCutchion	Coventry Aeroplane Club	11.3.39
17,359	Margery Joan Small	Cinque Ports Flying Club	10.3.39
17,360	Colin Philip Lindsay-Nicholson	London Air Park Flying Club.	7.3.39
17,361	Stanley Leslie Leon Kingshott	London Air Park Flying Club.	16.3.39
17,362	Cecil William Stableforth	Strathtay Aero Club	16.3.39
17,363	James David Margrie	Bournemouth Flying Club	16.3.39
17,364	Andrew Ferrier Ritchie	Scottish Flying Club	15.3.39
17,365	Benjamin Gerald Heron	Bournemouth Flying Club	16.3.39

THE INDUSTRY

DEMONSTRATIONS ON THE SPOT : At the Leamington Spa works of Automotive Products Ltd., there is a showroom, a large section of which is devoted to the equipment made by the Lockheed division of the company. From the pilot's seat in the corner it is possible to control the hydraulically operated retractable undercarriage, flap- and bomb-gear. At the side can be seen two examples of the Avery aircraft wheel. The bomb-release gear suggests possibilities for dealing with unwanted callers.

Royal Visit to Rochester

A PLANT that is probably unique in its vast capacity for producing both military and civil flying boats was thoroughly inspected by Their Majesties the King and Queen on Tuesday of last week, when they visited the Rochester Works of Short Bros., Ltd.

The King and Queen were conducted round the works by Mr. Oswald Short (chairman), Air Marshal Sir Wilfrid Freeman (Air Member for Development and Production), Sir Charles Bruce-Gardner (chairman of the Society of British Aircraft Constructors) and Mr. Arthur Gouge (managing director of Short Bros., Ltd.).

Their Majesties saw the experimental tank and the shop where models are made, and thence entered the big assembly shop, where they were confronted with the striking spectacle of the hulls of the three 36-ton "G" class boats now under construction. They also made an internal inspection of the *Awarua* and the *Australia*, the modified Perseus-engined boats under construction for the Tasman Sea service. They then made a detailed inspection of one of the large number of Sunderlands now in full production. The King showed particular interest in the armament of the boat and its spacious quarters for the crew.

The Royal visitors next entered the adjacent assembly shops and watched the making of wing-tip floats and the building of Sunderland hulls on jigs.

After inspecting the tunnels in the hills behind the works, equipped as air raid shelters for the employees, Their Majesties proceeded to the slipway, where they watched Mr. J. Lankester Parker take off a Sunderland in drizzling rain and demonstrate it above the works.

Afterwards the King and Queen drove to Rochester Aerodrome and made an inspection of the Short landplanes under construction for Imperial Airways.

Plastics on Show

SOME very attractive new showrooms were formally opened last week by the British Xylonite Co., Ltd., at 4-7, Chiswell Street, Finsbury Square, London, E.C.1. Prominent among some hundreds of exhibits typical of the products of the Xylonite Co., of its associated concerns, and of customers using its materials is a section featuring the application of "Bexoid" cellulose-acetate sheeting to aircraft. Display panels show the Hawker Hurricane, Fairey Battle and Miles Master, and beneath them are displayed various parts in Bexoid, such as conduits, air scoops and fillets.

"Bexoid," which is made in both transparent and opaque forms, is claimed to be particularly amenable to moulding and not to become unduly brittle at low temperatures. It is also low in weight; the specific gravity figure is 1.3.

Another interesting material on exhibition in the new showrooms is "Armourbex," which is a variety of clear "Bexoid" reinforced with a ¼in. steel wire mesh—thus making it possible to build, among other things, glasshouses in which any number of stones can be thrown without the proverbial effects!

These materials are made by BX Plastics, Ltd., a subsidiary of the British Xylonite Co., whose works are at Hale End, London, E.4.

Soundproofing, Ltd.

SOUNDPROOFING, LTD., is temporarily moving its offices from Park Royal to more central premises at 25, Knightsbridge, London, S.W.1 (Telephone: Sloane 5695).

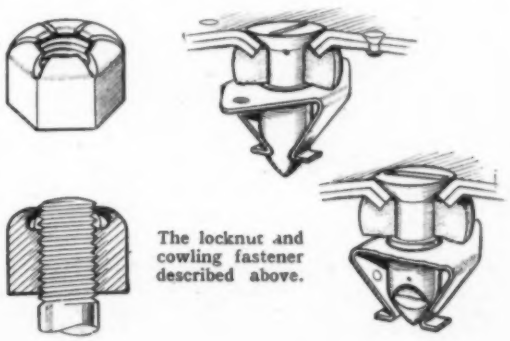
Security More Secure

FOR various reasons cowling fasteners have tended to be a source of trouble to ground engineers and others concerned. The fact is that they have had to put up with a very great deal of misuse, and by their very nature and position must suffer the effects of considerable vibration; yet if they are not easy and quick in action the point of their fitting is lost.

One of the most recent new types of fastener is the Oddie, which is not only extremely ingenious, but simple and virtually mistake-proof. Briefly, it consists of a two-blade spring of closed-U shape, into which the fastener stud is locked by means of slots cut on either side. Consequently, the stud, which has the usual screwdriver or coin slot in the head, has only two positions, and a glance at a series of fasteners on a cowling would show at once whether all were properly home.

Between the detachable cowling and the spring unit and mounting bracket is a hard rubber ring, which not only prevents rattle and keeps the cowling rigid, but also makes the fastener waterproof for use with sea-going machines. One important little point, in cases where time is vital, is that while the fasteners are being undone the studs can be turned round 180 deg. so that the cowling may afterwards be locked home securely merely by pressure.

While the Oddie fastener is being made by Oddie, Bradbury and Cull, of Southampton Airport, another safety device from the same firm is now being made by a new company—Oddie Lock Nuts—of Portland Terrace, Southampton. This device, as the firm's name implies, is a locknut of a simple and inexpensive all-metal type. In this, six tongues, which may be described as upper continuations of the hexagon sides of the nut, bite into the threads of the bolt. Since the tongue-ends are, so to speak, level with one another, the thread of the bolt is tending not only to force some of them out of place, but also to twist them as the nut is screwed on. The result is that, though the nut can always be moved with the aid of a spanner, it is to all intents and purposes rigid with the bolt. One of the important features of this nut is that the manufacturing processes are extremely simple.



The locknut and cowling fastener described above.

THE INDUSTRY (CONTINUED)

Simmonds' Welsh Factory Extension

IT is announced that Simmonds Aerocessories, Ltd., are to extend their factory at Treforest Trading Estate, South Wales, by 120,000 square feet. It is the first of extensions which will eventually bring the total area to 200,000 sq. ft.; this, it is claimed, will make it the largest factory on any Government-aided trading estate.

Airwork Appointment

THE recently inaugurated Gatwick Airport branch of Airwork, Ltd., is extremely busy and additional plant is being installed. The installation is being supervised by Mr. A. H. A. Bastable, who has recently taken up an appointment as planning engineer to Mr. R. S. Simpson, the works manager.

Production Machinery

SOLE agency in the British Isles for Bardons and Oliver (Cleveland, Ohio) turret lathes has been acquired by the Broadway Engineering Co., Ltd., Carlisle Road, Hendon, London, N.W.9.

These lathes, which are driven by motors mounted directly on the spindles, are electrically controlled and range in size from the No 1, with bar capacity of ⅝in. by 4¼in., to the No. 7 (2¾in. by 14in.). The smallest machine swings 11⅜in. and the largest 21¼in.

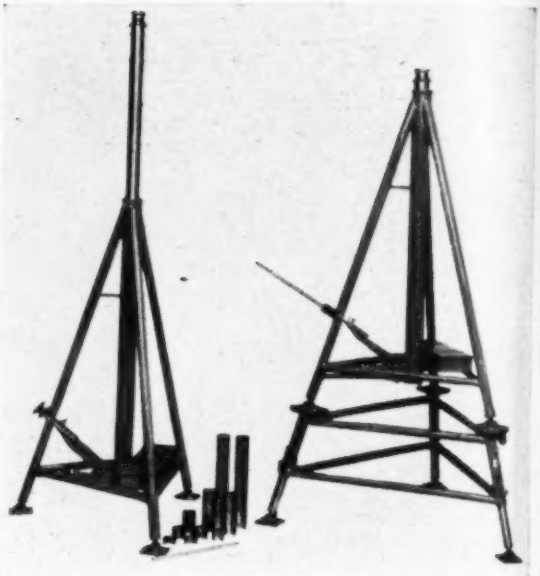
Aero Engines, Ltd.

A RECENT statement to shareholders by Aero Engines, Ltd., of Bristol, says that provisional accounts for the five months ended December 31, 1938, "show that the company is working at a profit which, in the opinion of the Board, may be considered satisfactory. During the period the factory was working considerably below capacity, and this condition still obtains, but the monthly turnover shows a steady increase and as additional equipment and supplies become available a further progressive increase to approximately full capacity should result."

Profile-projected Accuracy

PROFILE projection of plate gauges, form and press tools, screw threads, gear teeth, etc., by means of a new projector is described in a 22-page booklet published by Taylor, Taylor and Hobson, Ltd., of Leicester and London.

With this new projector the object to be examined is illuminated by collimated light, i.e., light in which the rays are brought into an accurately parallel formation. By means of special lenses and optical mirrors projection is obtained upon a horizontally mounted 5ft. table. A field of work of as much as 3in. diameter can be magnified twenty times. Alternatively, if a smaller field is required, the lenses are interchanged and images of up to 100 diameters can be secured.



FOR "BIG STUFF": These heavy-duty aircraft jacks, with capacities of three and five tons, are of the hydraulic type, the oil being stored in the tripod legs for transfer by hand-pump to the central lifting cylinder. Locking-members, seen between the two jacks, are used as a safety measure in the event of accidental use of the release valve. The model on the right is seen with tripod extension legs. These "Aerojacks," together with screw types (15 cwt. to 2 tons), are described in a list issued by Brown Brothers (Aircraft) Ltd., Great Eastern Street, London, E.C.2.

Gillett Stephen Progress

IT is announced by Gillett Stephen and Co., Ltd., of Great Bookham, Surrey, that their first year as a new company has, after making large reserves for depreciation and the provision of additional plant, resulted in the payment of a dividend of 7½ per cent. on the share capital.

This old-established aircraft engineering concern was reformed in October, 1937, and fresh capital was acquired for the purchase of modern equipment and the provision of adequate working capital.

Gillett Stephen are specialising in the production of hydraulic equipment for aircraft and there are large contracts on hand for various types of hydraulic retractable undercarriages and other actuating components.

AERONAUTICAL PATENT SPECIFICATIONS

(*Published March* 2, 1939)

12276. FRENKEL, E. W. (trading as FRENKEL, H. (Firm of)): Stiffening varnishes for aircraft (500,106).
14519. RATEAU, J.: Automatic piloting apparatus for air or maritime craft (499,861).
14751. HEBER, C., and MECHANISCHE WERKSTATTEN NEUBRANDENBURG GES: Electrical apparatus for discharging bombs from aircraft (499,862).
15122. ZEISS IKON AKT.-GES: Apparatus for use in bomb-dropping practice (500,107).
18171. SPERRY GYROSCOPE CO., INC.: Aircraft-locating devices (500,039).
21325. COX, H. R., and COOMBES, L. P.: Seaplane (499,883).
21446. ASKANIA-WERKE AKT.-GES VORM. CENTRALWERKSTATT DESSAU UND C. BAMBERG-FRIEDENAU: Means for regulating the fuel supply in internal-combustion engines (500,208).
21474. AIR EQUIPMENT: Winches, more particularly intended for aircraft (500,209).
21729. BOYD, P.: Course-calculating instruments for aeroplanes, airships, and the like (500,267).
22677. CRABTREE, H. S.: Safety-belts for maintaining passengers in the seats of aircraft or other vehicles (500,231).
27349. DEWANDRE, A.: Gun turret for aircraft (499,989).
34256. STEVENS, A. H. (United Aircraft Corporation): Propeller blades and method of making same (500,067).
1030. BARKLEY, A. ST. C.: Aerofoil structure (500,077).
7427. SOC. ANON. DES INDUSTRIES RADIO-ELECTRIQUES: Wireless direction-finding apparatus (500,006).
13183. REISSNER, H., and ARGUS MOTOREN GES: Screw propellers particularly for aircraft (499,932).
17335. SOC. ANON. DES INDUSTRIES RADIO-ELECTRIQUES: Radio antennæ (500,162).
22029. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES: Apparatus for use in electric welding (500,100).
22036. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES: Apparatus for use in joining structural members together by electric welding (500,101).
27118. AUBAREDE, P. C. A. M. D': Elastic mountings for engines carrying airscrew propellers (500,252).

(*Published March* 16, 1939.)

13125. SPERRY GYROSCOPE CO., LTD., HARDING, W. G., and NISBET, R. H.: Systems for transmitting indications (500,647).
13127. SPERRY GYROSCOPE CO., LTD., HARDING, W. G., and NISBET, R. H.: Systems for transmitting indications (500,648).
16487. SPERRY GYROSCOPE CO., LTD., HARDING, W. G., and NISBET, R. H.: Follow-up systems for sensitive indicators (500,652).
19376. SCHLUMBOHM, P., and POLLOPAS PATENTS, LTD.: Air-conditioning apparatus for ships, aircraft, and other conveyances (500,799).
22454. HAFNER, R.: Helicopters (501,014).
22666. BROWN, F. V., and AIRCRAFTINGS, LTD.: Valve devices particularly adapted for use in connection with aircraft tanks (500,966).
22810. BRONZAVIA SOC. ANON: Gas-dispensing apparatus especially for aircraft (500,976).
27868. DOWTY, G. H.: Retractable undercarriages (500,814).
1846. AUTOMOTIVE PRODUCTS CO., LTD., CLENCH, E. C. S., and BLESTON, J. P.: Liquid pressure remote-control systems (500,673).
5524. MARTIN, J., and MARTIN-BAKER AIRCRAFT CO., LTD.: Mounting of guns in aeroplane wings and other hollow bodies subjected to wind pressure (500,836).
7534. BUGATTI, E.: Screw-propellers (500,679).
8954. AKT.-GES. HUNZIKER AND CIE, ZURICH, BAUSTOFFABRIKEN BRUGG, and OLTEN: Air bombs (500,919).
11124. DELANEY, C. T., and GALLAY, LTD.: Windows for aeroplanes, motor-cars and other vehicles (500,683).
12869. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Gun mountings for aircraft and other vehicles (500,924).
18408. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Propelling aircraft or other vehicles by means of screw propellers (500,783).
20333. MARTIN, J., and MARTIN-BAKER AIRCRAFT CO., LTD.: Mounting of guns in aeroplane wings and other hollow bodies (500,856).
27073. YOXALL, J., and PROPELLO INVENTIONS, LTD.: Revolving cylinder, fluid pump, or motor (500,937).
29334. DEWANDRE, A.: Gun turret for aircraft (500,712).
36627. SPERRY GYROSCOPE CO., LTD., HARDING, W. G., and NISBET, R. H.: Electrical transmission systems (500,714).
37101. SPERRY GYROSCOPE CO., LTD., HARDING, W. G., and NISBET, R. H.: Electrical transmission systems (500,715).

THE AIRCRAFT ENGINEER

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CONTROL AXES

An Overlooked Factor : The Influence of Fuselage Inertia on Lateral Control

By W. E. GRAY, D.F.C.

THE importance of arriving at a sound basis on which to compare lateral control test results arises, of course, from the fact that at large angles of incidence it has always been rather easy to lose control of one's aeroplane temporarily, with very serious results if near the ground; and even after thirty-four years of flying, good men and valuable machines continue to go to destruction through loss of control. This loss may be due to misuse of the controls by the pilot or to inadequacy of the controls for their purpose—and lateral control has nearly always suffered from this inadequacy, as witnessed by the long-standing custom of judging one's nearness to the stall by the weakness of this control. In fact the inability of the lateral control to give the pilot power *in all circumstances* to roll his machine, even in a spin, has probably been responsible for more loss of life than any other single factor.

Past Methods

Ever since data from control experiments began to be collected there has been a need for some basis on which to compare the results, so that sound conclusions could be drawn from the various sets of experiments. Hitherto it has been customary to measure the power of an aeroplane control by the turning moment it can exert on the machine about its centre of gravity with reference to rather arbitrarily chosen "body axes." This basis of comparison seems to have proved satisfactory when considering rudder action, and also aileron action at the smaller incidences, but when applied to ailerons at the higher incidences the method appears to be unsound and misleading. It is with special reference to lateral control at these higher incidences that it is proposed to review the question of axes. Attention will be drawn to an important factor that appears to have escaped notice so far, namely, the influence of the fuselage inertia on the motion caused by the ailerons. That lateral control is still a problem after years of research perhaps lends weight to the suggestion that something has been overlooked, and it may be that the oversight is due to the fact that the mathematicians who are in the habit of studying these problems are not usually themselves pilots.

Since "chord" axes and "body" axes are almost the same, and as chord axes have no uniform meaning but vary with wing section, they will be treated as synonymous in what follows, and will be regarded as coinciding with the "wind axes" at an unspecified small value of the lift coefficient only. In other words, it will be assumed for clarity that the wing chord from which incidence is measured is parallel to the principal X-axis of inertia of the aeroplane. Now, the authorities on control and stability, at any rate in this country, hold the view (and have for years) that a lateral control should exert a rolling moment about the longitudinal "body" axis without any accompanying yawing moment about the yawing "body" axis. Yet it is difficult to understand how this body-axis belief arose as a proper basis on which to compare lateral controls, for it is surely obvious that if an aeroplane is flying near the stall, with its fuselage at a large angle to the flight path, and it is rolled about its body axis one wing-tip will immediately be ahead of the other and the machine will be flying with sideslip. Now it is not the slightest good having a supposed lateral control that acts with changing incidence as a wildly-varying combination of aileron and rudder; it is a treacherous arrangement.

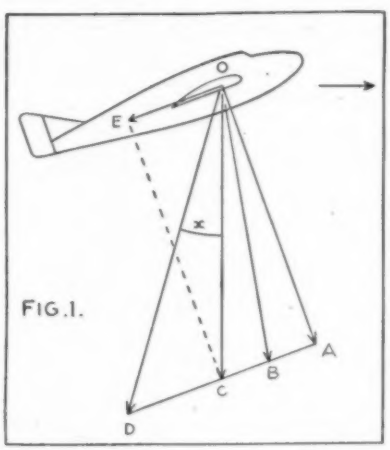


FIG. 1.

Authoritative Nonsense

For the above reason it is fundamental that the lateral control ought to roll the aeroplane about the "wind axis" or direction of motion, for it is well known that if sideslip is introduced at high incidence, a powerful rolling moment is set up. It follows that the plotting of rolling and yawing moments on a body-axis basis in a vector diagram for the purpose of assessing the merits of a lateral control is just plain nonsense—with all due respect to the eminent men who compose the Stability and Control Sub-Committee of the Aeronautical Research Committee. It is probably due to this Sub-Committee or Panel, in issuing their general report in 1926 (R. & M. 1000) on the lateral control of stalled aeroplanes, that the body axes have been regarded for so long as sound. In their conclusions they said that they had, in a measure, reached "a thorough understanding of the principles governing the control of stalled aircraft," and one of the chief conclusions was that a lateral control should not exert any yawing moment about body axes; thus was an apparent seal of authenticity set upon these axes. It would seem that their rightful anxiety to condemn ailerons that dragged as they lifted, with reference to body axes, had blinded them to the fact that ailerons giving pure rolling about the body axis are still terribly bad at high incidence.

When wind-tunnel tests of a lateral control are carried out in this country, the tunnel measurements are made about wind axes, but the results are converted to body axes for comparison with other data, and although there has been much talk recently of "favourable" and "unfavourable" yaw, this talk has been of a loose nature, and nobody seems to have made up his mind how much "favourable" yaw *is* favourable. In short, the A.R.C. have made no real attempt to enquire into the soundness of the basis on which control comparisons are being made, or to find a fixed anchorage for the vague talk about yawing moments. It seems certain that the axes question is retarding the search for better lateral control, and it is in the hope of provoking a fresh consideration of this important matter that these notes have been written.

American Views

It is encouraging to find that, in some of the more recent N.A.C.A. reports, the Americans (who at the beginning of a long series of tunnel and flight tests of lateral controls were quite adamant about the body axes being the only valid ones) have later slipped quietly into the use of wind axes "in order to correspond to the pilot's reactions to the motion of the airplane." Surely pilots' reactions alone are not sufficient ground for changing the basis of a scientific investigation without sound reasons as well! So if they became convinced that body axes were unsound, why not say so frankly and give the reasons, instead of glossing over the change of front?

The Problem, Simply

If anyone doubts the soundness of rolling the aeroplane about the wind axis, let him mount a wing near the stall in a tunnel so that it is free to roll about its chord axis, and he will see how strenuously it resists any attempt to roll it. If left to itself, however, it will start oscillations of increasing violence as soon as any stalling takes place; this behaviour seems to be similar to that of the full-scale aeroplane when ailerons are used to roll a machine near the stall. It begins to roll, but then reverses the roll and spins the other way. The effect can also be observed with a small dynamic flying model.

Consider now the influence of inertia on lateral control. Apart from the obvious factors of rolling power of the control, damping in roll of the wing, and inertia of the wing, there are three other main factors which govern lateral control at high incidence, namely, the line of action of the control force applied, the line of action of the altered air forces on the wing due to the rolling, and the inertia of the other parts of the aeroplane, especially the body; these three factors govern the generation of yaw, which is so potent at high incidence.

The importance of body inertia can be seen if a very simple case is taken, and the air forces are for the moment ignored. Suppose an aeroplane is flying level at 15° incidence and its fuselage is very light and its wing very heavy, then, if a vertical controlling force is applied to one wing tip, that tip will move almost vertically, and the machine will roll about the wind axis. If, however, the wing should be very light and the fuselage heavy, then the machine will roll almost about its body axis. (If anyone doubts this it is easy to verify with a crude model.) It will thus be seen that, even though the air forces of control and damping may act only about the wind axis, yet the fuselage can, by its inertia, have a bad effect on the motion of the machine in roll. This is the point that it is particularly desired should be brought out, and this is why the N.A.C.A., in changing from body to wind axis, has still not reached a sound basis on which to compare lateral controls.

It may perhaps be argued that the rudder is always available for the pilot to counteract the unwanted yawing effect of the ailerons, but three separate controls are quite enough already without having two of them inextricably mixed as well, and it is unfair to the pilot to inflict this on him. An aeroplane can, of course, be controlled in roll at the stall by the rudder alone, through the rolling moment due to yaw, but anyone who has tried it will agree that it is a precarious and unsatisfactory method.

Let us now consider the body inertia effect more carefully with reference to Fig. 1, in which the aeroplane is flying level at a high incidence. Ignoring the air reactions for the moment, we see that if a controlling force OA is applied to one wing tip, and at right angles to the body axis OE, the machine will roll about this axis, and the wing tip will move along OA. But if the control force is about the wind axis, as denoted by OC, then the body inertia comes into play. Were it not for this, the wing tip would move along OC (as it might in a tailless design). Now, since the fuselage inertia and the wing inertia are both of the same order of magnitude in the average machine, let us take the case where they are equal. Resolving OC into OA and OE (its components about inertia axes) we see that, while OA is overcoming the wing inertia, OE has to cope with the fuselage inertia as well, so that the angular acceleration in yaw will be halved in consequence, and the wing tip will move along OB instead of along OC. Thus the application of a wind-axis force OC does not produce a wind-axis motion in roll. To secure this, the applied control force would have to be along OD, where AC=CD. It follows that the angle X is nearly equal to the incidence if this is small, but is somewhat less than equal at large incidences.

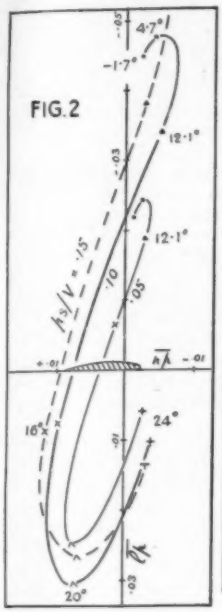
We thus see that, so far as the inertia effects are concerned, we must push a wing back as well as down, or forward as well as up, even with reference to the wind axes, if we wish to roll the machine about the wind axis or to check such a roll. The angle at which the control force must act depends on the ratio of body-to-wing inertia, as we have seen; the greater the body inertia the greater the angle X.

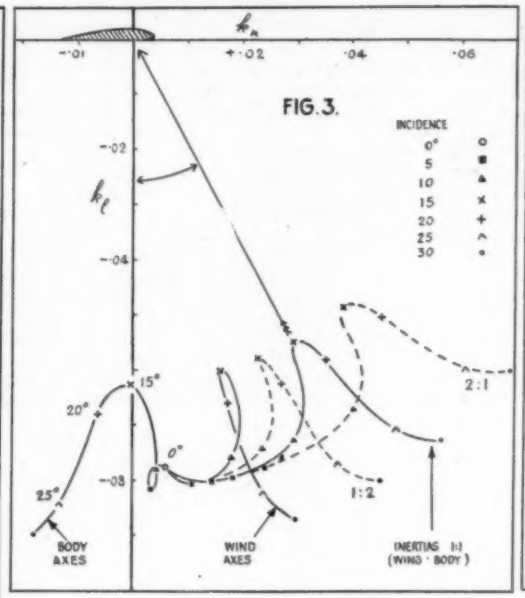
Damping in Roll

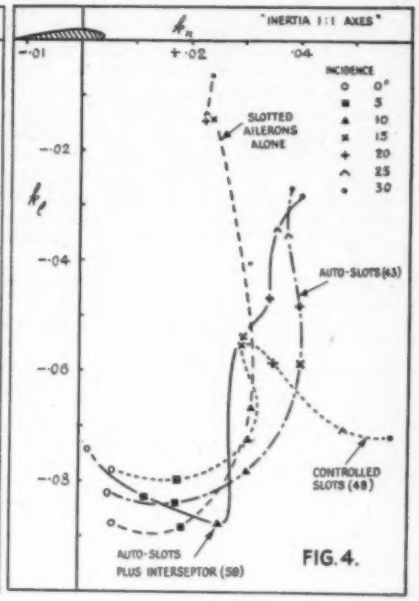
Let us now see just how the aeroplane resists our attempts to roll it about the wind axis as regards air reactions. It is obvious that at large incidences the fin, rudder and fuselage surfaces will exert a damping force, as well as that due to the wing. All these are allowed for in Fig. 2, which has been plotted from data in R. & M. 1743, giving rolling and yawing moments due to roll, on a wind-axis basis, for a complete model Puss Moth. The curves are for three rates of roll (for the ratios of tip speed to forward speed of .05, .10 and .15) and are plotted vectorially. It will be seen that if a wing is pushed down while at 12.1 deg. incidence it resists, and also tries to move forward, at each of the three speeds. The size and direction of the damping force is represented by a vector from the origin to the 12.1 deg. point on the curve in question.

Below the stall, it will be seen, the inclinations of these vectors to the wind axes are not very far removed from their incidence values, especially at the lower rates of roll. This is very fortunate, for it means that the control force needed to overcome the damping must be inclined at about the same angle(X) to the wind axis as we have already seen is required by inertia considerations; that is if yawing with regard to the wind axis is to be avoided. What is also fortunate is that if a roll about the wind axis is allowed to damp itself out, or if it is checked and reversed by the lateral control, the inclination is appropriate in all these circumstances too—that is if the wing and body inertias are about equal, or if the body inertia is somewhat the smaller, and if, of course, a lateral control can be found to supply the desired effect!

If a rapid roll is performed near the stall the case is rather altered. It will be seen that if a wing is depressed so quickly that it begins to stall it drags back. If the incidence is 16° and the rate of roll .10 or .15 autorotation sets in, and the falling wing needs even more yawing moment to hold it forward than it does rolling moment to hold it up (vectors from 16 deg. to origin). It is difficult to see how this change-over in behaviour almost at the stall can be catered for in a lateral control, so that it is perhaps fortunate that one does not usually try to







manœuvre violently near the stall when the necessary surplus speed is lacking.

It should be noted that the inertia influence is only of importance in accelerated motion in roll. But, after all, the greater part of flight manœuvres involves acceleration. It is of interest to note, in passing, that rolling about the wind axis will set up a stalling moment due to fuselage mass, for the same reason that a spin tends to flatten. During steady rates of roll the damping vector is the important factor, and the control vector should obviously cancel this without residual yawing moment if possible.

The Ideal Control

It has been seen that both the British and American views of zero yaw about body and wind axes are unsound, and that inertia effects must be designed for. Since inertia ratios vary widely, one design cannot suit all types. Wing inertia predominates on the lightly-loaded types, and body inertia on the heavy ones, even with wing engines.

Unfortunately the Puss Moth results are fairly typical of all machines, so only at one inertia ratio can the aerodynamic and inertia requirements be met to a nicety; but as aeroplanes *do* fly with far from ideal ailerons, a fair inertia latitude would appear to be allowable.

The point of having what has been called "excessive favourable yaw" is important. This may seem an easy way of supplementing poor aileron power at high incidence by drawing upon the rolling moment due to yaw, but it defeats itself because it becomes impossible to check a roll started in this way owing to the yawed attitude. Moreover, as the Americans have found, it pulls the nose down badly on entering tight turns.

American Conclusions

The most recent study of the problem by the N.A.C.A. is its Report No. 570, and in this the wind axes are taken as the proper basis for lateral control comparisons. But it is abundantly clear from Fig. 20 and the accompanying text that the constraining influence of the fuselage inertia has not been taken into account at all, for the conclusion is reached that any aileron yawing moment with respect to wind axes must be counteracted by the rudder at the very beginning of a turn if sideslip is not to develop. It is further suggested that the bad effect of ailerons with adverse yawing moment can be reduced by increasing the yawing moment of inertia of the aeroplane, but no distinction is drawn between distributing the mass along the body as opposed to distributing it along the wings.

Lateral Controls

Existing and experimental controls will now be analysed in the light of the inertia aspect. Pride of place should perhaps be given to the tip slot, which has improved control in recent years. Mr. Handley Page's Wilbur Wright lecture of 1928 to the Royal Aeronautical Society will be drawn on for data, being the only comprehensive source. It seems a pity that so eminent an authority as Mr. Handley Page accepted the body axes as the final expression of truth, and that Mr. Russell followed suit in his article in *The Aircraft Engineer* of February, 1930.

Fig. 3 gives vector diagrams to true scale of the aileron-plus-controlled-slot curve of Fig. 48 of the lecture. On the left is the body axis plotting of Mr. Handley Page, and on the right are four plottings, on various bases but all radiating from the same zero incidence point. In every case the ideal control would lie on the vertical line and would have no yawing moment about the axis in question. If the body axes were a true criterion, the body-axis curve would give a true picture; and if the wind axes were sound, that curve would be the true one (the latter curve is derived from the former by angular displacement). The three curves for various inertia ratios show how the control gets farther from the ideal with each increase in body inertia for the reasons that were explained earlier.

We see from the body-axis curve that at 15 deg. incidence the slot-and-aileron control gives a vector at right angles to the chord and will roll the machine about the body axis. If the machine is to be rolled about the wind axis and it has no fuselage inertia it is seen that by joining the 15 deg. point on the wind-axis curve to the origin we get a vector that is 15 deg. out of its ideal direction. Similarly, if the body and wing inertias are equal, the vector in Fig. 3 from the peak of that curve is nearly 30° out of line; reference to Fig. 1 will make this clear. The dotted curves for the more extreme inertia ratios require the qualification that, even if they were brought on to the zero line, the control would only be ideal when dealing with the inertia forces, for as we saw earlier the aerodynamic forces require somewhat different control reactions.

The wing section is placed at the origin merely to assist visualisation, and represents the aeroplane rather than the actual wing, in Figs. 2-5.

Since the inertia ratio of 1 : 1 represents a rough average

of aeroplanes in use, and since at that ratio the aerodynamic and inertia requirements are in a reasonable measure of agreement, the ratio will be standardised in all that follows. In Fig. 4 the best examples of various controls in the Wilbur Wright lecture are given on this "inertia axes" plotting, and the numbers refer to the lecture diagrams. The ailerons are slotted and at ±20 deg., and the R.A.F. 28 section rectangular wing stalls at about 11 deg. It will be seen that, up to the stall, none of the controls gives a radical improvement over the ailerons alone. Beyond the stall, however, where the vector angle of the ailerons alone is shocking, all three controls give a

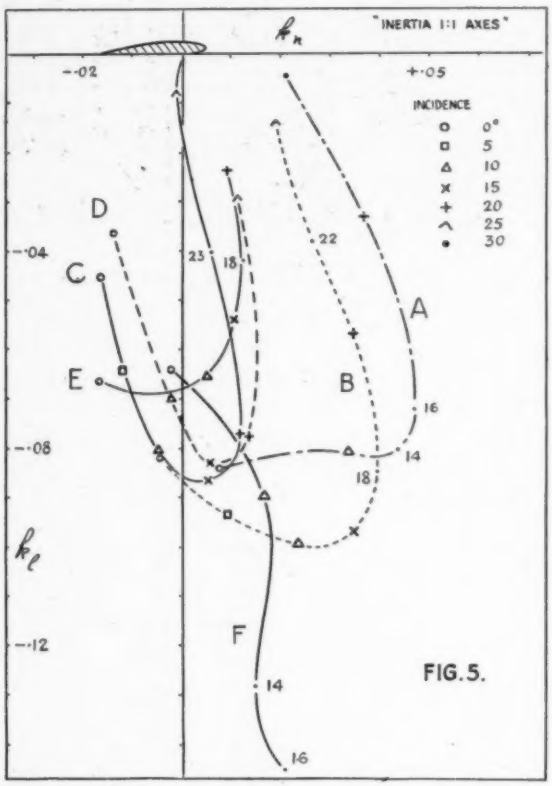


FIG. 5.

big improvement in power and angle, though still very far from the ideal. It is surprising that the interceptor does not change the auto-slots curve more radically.

Fig. 5 gives the results of a number of N.A.C.A. tests on a rectangular Clark Y wing which stalls at about 17°. Curve A shows "standard" ailerons at ±30 deg., and it is obvious how bad these are at all the higher incidences; intermediate incidence points are numbered on the curves. Curve B shows the improvement due to adding a short spoiler near the leading edge, inboard of the aileron, and giving a medium differential to the ailerons (+15° and −35°). It should be mentioned that only in the latter part of the travel of extreme differential ailerons is there much improvement in yawing moment, so this device does not help greatly.

Curve C shows control by a spoiler on the outboard part of the wing, near the leading edge. It will be seen that control at the stall is nearly ideal. Control at small incidence involves too much yaw, however, and would be bad in tight turns or when holding a compass course in bumps; besides, the spoiler is subject to "lag." Curve D is for the new "slot-lip" aileron at .3 chord; this is similar to the spoiler except for its lag, drag and "sluggishness." Curve E is for a retractable arc aileron on the upper surface near the trailing edge (.85c), and shows bad loss of power at the stall, and apparently too much drag at high speed; however, for the smaller deflections then used the drag is not bad at high speed.

It should be remembered that these curves are for full aileron deflection only. The variations with deflection have been plotted for incidences of 0 deg. and 15 deg. In all the cases of Fig. 5 they are nearly straight lines, except for the arc aileron, which for small deflections falls nearer the ideal at high speed and farther from it at low speed.

It is worth mentioning a control invented by Irving of the N.P.L. in 1920; the form known as "Hole and Shutters H" gives a curve of the general shape of a spoiler curve at the smaller incidences and of Curve B in the stall region.

Finally, Curve F is of some interest as it represents an attempt by the writer during this study to devise a control that will approach the ideal which has been advanced. It is based on wind-tunnel tests on a Clark Y wing and so compares with the other Fig. 5 curves; control at high speed and near the stall are close to the ideal, but around 10 deg. there is still some unwanted yaw. It is at least encouraging, as it should not be subject to lag nor add drag.

A *Suggestion*

It must be remembered that all lateral control tests are on stationary wings, whereas rolling-balance tests are all made with ailerons neutral. There is no certainty that the answers will be the same, especially as regards yawing moments, when displaced ailerons are combined with a rotating model. It is suggested that the A.R.C. should test a model for yawing moments while rotating freely under its ailerons; the rate of roll will give some check on the balance of rolling moments at the same time.

In conclusion, enough has been said to show the need for a fresh consideration, with open minds, of this axis problem. That is a duty which falls primarily to the Stability and Control Committee of the A.R.C., and it is to be hoped that it will tackle it promptly so that progress towards better control and safety may be speeded up.

TUNGSTEN CARBIDE DEVELOPMENTS

IN many respects carbide-tipped tools are an innovation. They have characteristics unfamiliar to many—characteristics which affect their use and application. So that they may be more easily understood, Mr. H. Burden, B.Sc., has written an unusual treatise entitled *The Manufacture and Use of Cemented Carbide Tools*.

After a brief reference to the discovery and history of the inter-metallic compound, tungsten mono-carbide, the paper deals at length with the methods of manufacture. Utilising the cold press method, the mono-carbide is broken down by crushing and is then mixed with cobalt in a ball-mill. The resulting mixture is an exceedingly fine powder which is pressed into blocks of suitable size and shape for the production of tool tips. The blocks are then subjected to a special heat treatment before being cut to shape and finally sintered.

The paper describes the physical changes which take place during this sintering process before going on to deal with carbides of metals other than tungsten, such as tantalum, titanium and molybdenum carbides. Finally the author deals at length with the various applications possible with the carbide tool. He emphasises the fact that many operations carried out to-day with high-speed steel and similar alloys can be conducted much more efficiently with carbide tools, but he adds that this does not necessarily imply that with further development carbide tools will replace high-speed steel for all purposes. He suggests, however, that just as high-speed steel at one time replaced carbon steel for certain work so has carbide established for itself a similar position for certain types of duty.

Mr. Burden is a member of the staff of the Research Department of Thomas Firth and John Brown, Ltd., of Atlas Works and Norfolk Works, Sheffield, 1, from which address a copy of the paper is obtainable.